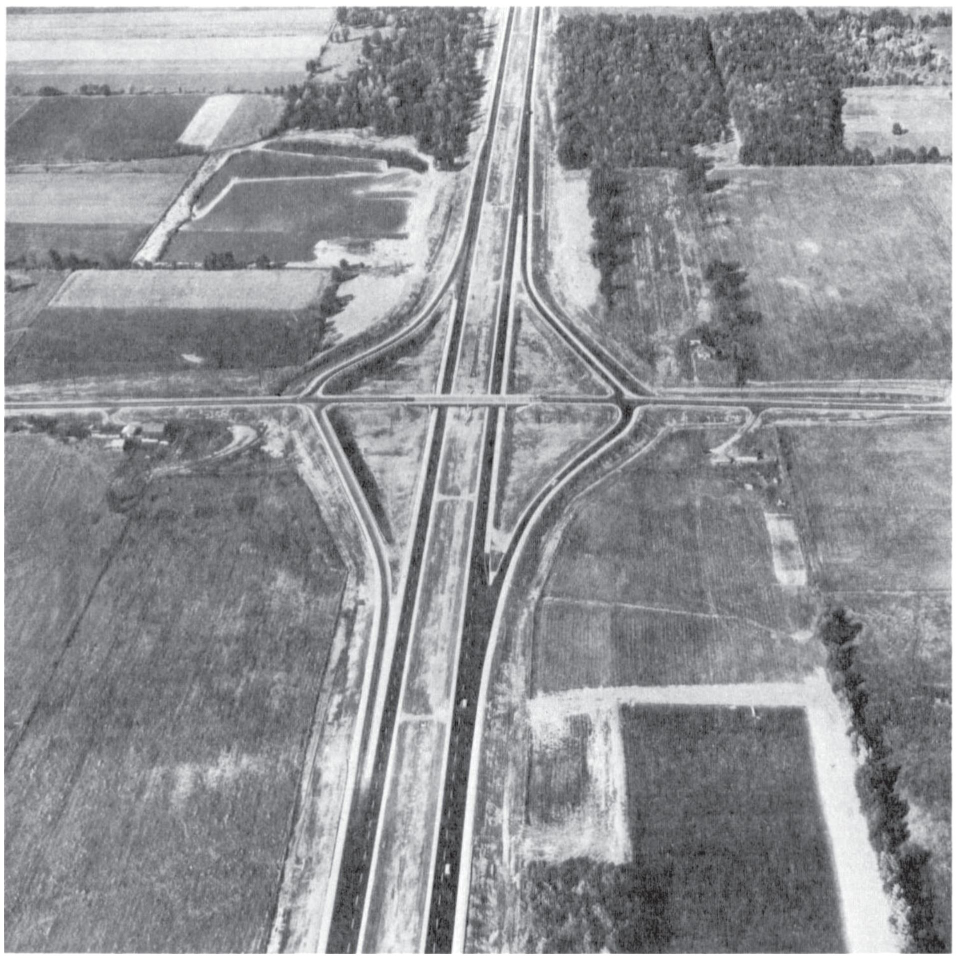
Issued July, 1969

Soil Survey
DELAWARE COUNTY
Ohio



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
OHIO DEPARTMENT OF NATURAL RESOURCES
Division of Lands and Soil
and
OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

Major fieldwork for this soil survey was done in the period 1960–62. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1962. This survey was made by the Soil Conservation Service in cooperation with the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Delaware Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. 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 in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described and also the page for the capability unit in which the soil has been placed.

Interpretations not included in the text can be developed by using the soil map and 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 in the soil descriptions and in the discussions of the capability units.

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

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Use of Soils for Wildlife and Fish."

Community planners and others concerned with land use planning can read about the soil properties that affect the choice of homesites, industrial sites, schools, and parks in the section "Soils and Land Use Planning."

Engineers and builders will find under "Engineering Uses of Soils" tables that estimate behavior of soils where used as locations for highways; as sites for terraces and similar soil-conserving structures on farms; as locations for homes and related sewage disposal systems, lawns and landscaping, and streets and parking lots; and as sites for campgrounds, athletic fields, and other recreation areas.

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

Newcomers in Delaware 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 section "General Nature of the County."

***Cover picture.*—Competing uses of soils in the Bennington-Pewamo-Cardington soil association near the intersection of Interstate Highway No. 71 and U.S. Highway No. 36. The soils are used for cultivated fields, woodland, a borrow pit (right foreground), and highways.**

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Contents

Issued July 1969

SOIL SURVEY OF DELAWARE COUNTY, OHIO

BY FRANCISCO MATANZO, KENNETH L. STONE, JR., R. D. THOMPSON, AND KENNETH H. WENNER, SOIL CONSERVATION SERVICE[1]

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

DELAWARE COUNTY, in the central part of Ohio (fig. 1), has a total land area of about 440 square miles, or 281,600 acres. Delaware, the county seat, is near the center of the county.

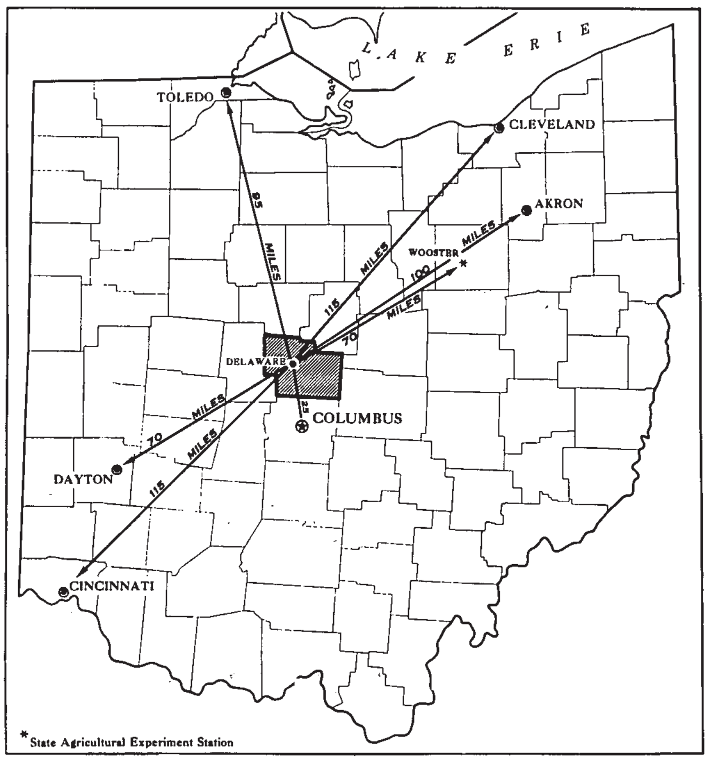

Figure 1.—Location of Delaware County in Ohio.

Delaware County is in the Central Lowlands and lies entirely within the area known as the Till Plain. Its eastern boundary is about 10 miles west of a line that divides the Central Lowlands from the Allegheny Plateau. Most of the soils in the county formed from moderately fine textured glacial till of Wisconsin age.

Large areas in this county consist of deep, nearly level or gently sloping soils that are well suited to farming. Corn, wheat, oats, soybeans, and hay are the principal crops. The grain crops are used mainly as feed for livestock. More than half of the farm income is from the sale of livestock and livestock products. The county normally receives enough rainfall for the crops that are grown, but in some years crop yields may be slightly reduced because of drought.

Delaware County is only a few miles north of the expanding metropolitan area of Columbus, Ohio, and an increasingly large acreage, particularly in the southern part of the county, is being diverted to nonfarm use.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Delaware County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; 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 to the soil material or rock material that has not been changed much by leaching or by roots of plants.

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. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

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. Alexandria and Fox, for example, are the names of two soil series. All the soils in the United States having the same series name are

[1] Assisting with the fieldwork were JAMES E. BOMAN, MARVIN BUREAU, GEORGE DISRUD, JOSEPH ELDER, EVERETT C. FLESHER, FREDERICK P. MILLER, CHARLES POWERS, and WILLIAM H. SHUMATE, Soil Conservation Service.

essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Fox silt loam and Fox loam are two soil types in the Fox series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and sizes of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Alexandria silt loam, 6 to 12 percent slopes, is one of several phases of Alexandria silt loam, a soil type that ranges from sloping to steep.

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 woodland, buildings, field borders, roads, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this soil survey was prepared by aerial photographs, as the base maps.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. 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 kinds that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delinating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Casco-Fox loams, 12 to 25 percent slopes, moderately eroded. In some places two or more similar soils are mapped as a single unit, called an undifferentiated soil group, if the differences between the soils are too small to justify separate mapping. An example in this county is Alexandria and Morley silt loams, 25 to 40 percent slopes, moderately eroded. Most soil surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but are given descriptive names, such as Marsh or Rock land, and are called land types.

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 soils 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 soils. Yields under defined management are estimated for most of the soils in the county.

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 a way that it is readily useful to different groups of readers, among them farmers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil surveys. On the basis of the yield and practice tables and other data, the soil scientists set up trial groups, and then test these by further study and by consultation with farmers, agronomists, engineers, and others. The scientists 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 present 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 Delaware 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 farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, or other characteristics that affect management.

Delaware County is in the Till Plain area of the Central Lowlands. The county is covered by glacial drift of Wisconsin age that has greatly subdued the relief that existed before the advance of the glaciers. The relief of the county is mainly gently rolling or undulating, but some areas are steeper. Of the six soil associations in this county, five consists of soils on a glacial till plain, and one is made up of soils on flood plains, outwash terraces, kames, and eskers.

The soil associations in Delaware County shown on the general soil map are described in the following pages.

1. Morley-Blount Association

Moderately well drained and somewhat poorly drained, gently sloping to steep soils on an undulating high-lime glacial till plain

This soil association occupies relatively narrow strips in the western part of the county. It consists mainly of gently sloping to steep soils on uplands along the Scioto and Olentangy Rivers, Delaware Run, and Mill Creek. Within the association are a large part of the town of Delaware and parts of Ostrander and Powell. The association covers about 10 percent of the land in the county.

Morley soils occupy about 55 percent of this association; Blount soils, about 40 percent; and minor soils, the remaining 5 percent.

Morley soils are deep, light colored, and in most places moderately well drained. They are the steepest soils in the association. Blount soils are deep, light colored, and somewhat poorly drained.

The minor soils include the very poorly drained Pewamo and the well-drained Fox.

Most of this association is used for cultivated crops. The main limitations to farming are erosion on the Morley soils and seasonal wetness on the Blount. Many nonfarm uses are limited by the restricted internal drainage of the dominant soils.

2. Blount-Pewamo Association

Somewhat poorly drained and very poorly drained, nearly level to gently sloping soils on an undulating high-lime glacial till plain

This soil association consists of broad areas of nearly level and gently sloping soils in the northern and western parts of this county. It covers about 30 percent of the land in the county. In plowed areas or bare fields, a distinct pattern of the light-colored Blount and the dark-colored Pewamo soils can be seen.

The Blount soils make up about 45 percent of the association, and the Pewamo soils, about 40 percent. Scattered areas of the well-drained Morley soils make up most of the remaining 15 percent.

Blount soils are on low knolls in the association and are somewhat poorly drained. The Pewamo soils are nearly level or depressional and are very poorly drained.

This soil association is used mainly for general farming; the emphasis is on cultivated crops. Crops can be grown successfully on the major soils if they are drained. Use for many nonfarm purposes is limited by restricted internal drainage.

3. Cardington-Alexandria Association

Moderately well drained and well drained, gently sloping to steep soils on an undulating low-lime glacial till plain

This soil association occupies long, narrow areas in the eastern and central parts of this county. It consists mainly of gently sloping to steep soils on uplands along Alum, Little Walnut, and Big Walnut Creeks and in an area on the eastern side of the Olentangy River. This association makes up about 10 percent of the land in the county.

The Cardington soils occupy about 55 percent of this association; the Alexandria soils, about 35 percent; and Colyer and Pewamo soils, the remaining 10 percent.

The Cardington and Alexandria soils are deep and light colored. The Cardington soils are mostly gently sloping to sloping and are moderately well drained. The Alexandria soils are well drained and sloping to strongly sloping. Generally they are near streams.

Of the minor soils, the Colyer soils are well drained, very steep, and shallow, and the Pewamo soils are deep and very poorly drained.

This association is used mainly for cultivated crops. Areas of Colyer soils generally are wooded. The hazard of erosion is the main limitation to the use of the Cardington and Alexandria soils for farming. For many nonfarm uses, these soils are limited by moderately slow permeability and, in some areas, steep slopes.

4. Bennington-Pewamo-Cardington Association

Somewhat poorly drained, very poorly drained, and moderately well drained, nearly level to steep soils on an undulating low-lime glacial till plain

This association occurs throughout the eastern and central parts of the county (fig. 2). It consists mainly of nearly level to gently sloping soils in broad areas, but a few small areas of very steep soils are along the breaks of the main streams. This association covers about 32 percent of the land in the county.

Bennington soils occupy about 45 percent of this association; Pewamo soils, about 30 percent; Cardington soils, about 20 percent; and minor soils, the remaining 5 percent.

The Bennington soils are light colored, nearly level and sloping, and somewhat poorly drained. In most areas they have formed in thick glacial till material, but in a small area on the eastern side of the Hoover Reservoir, they are underlain by shale at a depth of about 50 inches. The Pewamo soils are dark colored, nearly level, and very poorly drained. Cardington soils are light colored and moderately well drained. In plowed or bare areas the dark-colored Pewamo soils and the light-colored Bennington and Cardington soils form a distinctive pattern.

The minor soils are the poorly drained Condit and the well-drained Rarden. The Rarden soils are underlain by reddish shale and occur with the Bennington soils that have a shale substratum.

This association is used mostly for cultivated crops, but the steep breaks along Alum Creek are wooded. The wet Bennington and Pewamo soils can be drained. Crops grow well on the Pewamo soils if they are adequately drained. The Cardington soils are seasonally wet, but they can be cultivated earlier in the spring than the adjacent Bennington soils because they dry out earlier. For many nonfarm uses, all of these soils are limited by seasonal wetness and moderately slow permeability.

5. Morley-Milton Association

Moderately well drained soils on high-lime glacial till and well drained soils on high-lime glacial till over limestone

This association consists of gently sloping to steep soils that occur along the eastern side of the Scioto River in the northwestern and southwestern parts of this county and along Eversole Run on the western side of the Scioto River in the southwestern part of the county. This association covers about 5 percent of the land in the county.

The Morley soils occupy about 45 percent of this association; the Milton soils, about 16 percent; and minor soils, the remaining 39 percent.

The Morley soils are nearly level to steep, but they are gently sloping in the largest acreage. They are underlain by glacial till and are moderately well drained. The Milton soils also are mostly gently sloping, but they range from nearly level to moderately steep and are well drained. Milton soils formed in glacial till that is underlain by limestone at a depth of 20 to 40 inches. Both the Morley and the Milton soils are light colored.

Among the minor soils in this association are the somewhat poorly drained Randolph soils and the very poorly

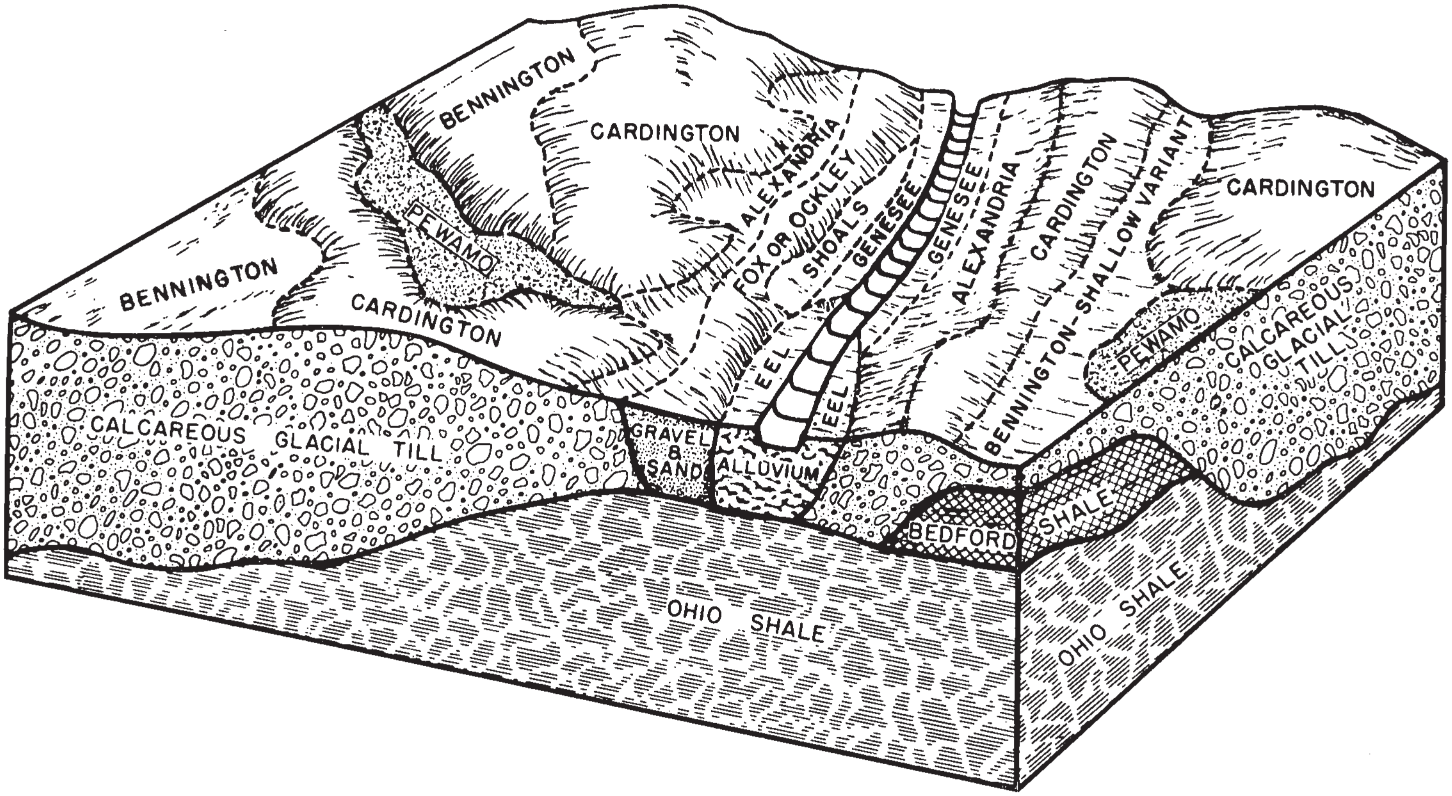

Figure 2.—**Major soils in the Bennington-Pewamo-Cardington soil association and their underlying material.**

drained Millsdale soils. These minor soils are underlain by limestone at a depth of less than 40 inches.

A large part of this association is cultivated. Erosion control and other conservation practices are needed in cultivated areas of the Morley and Milton soils. The areas of minor soils need drainage, but the limestone makes drainage difficult. For many nonfarm uses, the Morley soils are limited by slow permeability and the Milton soils are limited by shallowness to limestone.

6. Eel-Fox Association

Moderately well drained soils on flood plains and well drained soils on outwash terraces, kames, and eskers

This soil association occurs mainly on the bottom lands and the terraces along the Scioto and Olentangy Rivers and along Alum, Big Walnut, Fulton, and Bokes Creeks. Hilly to steep kames and eskers are in a small area near Radnor. This association covers about 13 percent of the land in the county.

The Eel soils occupy about 50 percent of this association; the Fox soils, about 40 percent; and minor soils, the remaining 10 percent.

The Eel soils occur on the flood plains and are nearly level and moderately well drained. The Fox soils are well drained. Most of their acreage is on low terraces along streams, but near the town of Radnor, Fox soils are closely intermingled with the Casco soils in a small hilly to steep area. The Fox soils are nearly level to gently sloping in most places.

In addition to the well-drained Casco soils, the minor soils in this association include the deep, well-drained Genesee soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils.

Most of this association is used for cultivated crops. Under good management, the major soils are suitable for farming. On the Eel soils flooding is a hazard, particularly in winter and spring. Except in the nearly level areas, erosion is a hazard in cultivated areas of Fox soils. Because slopes are steep and the Casco soils are shallow, the small areas of closely intermingled Fox and Casco soils on uplands near Radnor are of limited use for cultivated crops. In many places the Fox and Casco soils are suitable as sources of sand and gravel. Steep slopes in the upland areas and flooding on bottom lands are the major limitations to most nonfarm uses of all of these soils.

Use and Management of Soils

This section contains information on the management of soils for crops and pasture and also as woodland, for wildlife, in engineering, and for land use planning. Also given are the estimated yields of the principal crops.

In presenting information about the use of soils for crops and pasture, the procedure is to describe a group made up of soils that respond to management in about the same way. The groups are called capability units, and use and management of each are discussed. To determine the soils in each of these groups, refer to the "Guide to Mapping Units" at the back of this survey. In the section on engineering, the properties significant to engineering work are given for the soils. The section on wildlife gives information about the suitability of the soils for the elements of wildlife habitat. In the section on land use planning, the soils are rated according to their limitations for selected uses.

Management for Crops and Pasture

In this section, general practices of management are discussed, the system of capability classification is described, and a table lists estimated yields of principal crops under two levels of management.

Field crops commonly grown in Delaware County include corn and soybeans, and wheat, oats, and other small grains. Plants suitable for pasture and hay include alfalfa, alsike clover, Ladino clover, timothy, orchardgrass, and bromegrass. Special crops commonly grown are tomatoes, sweet corn, strawberries, cucumbers, cabbage, and other crops adapted to the climate.

General practices of management[2]

Although the soils in Delaware County vary in their suitability for specific crops and require widely different management, some basic, or general, management practices are needed on practically all of the soils. This section discusses the basic practices of maintaining fertility, utilizing crop residue, improving drainage, and controlling erosion. The management of specified groups of soils is discussed in the section "Management by Capability Units" beginning on page 6, but more specific information can be obtained by consulting a representative of the Soil Conservation Service or the Ohio Agricultural Extension Service.

Maintenance of adequate levels of fertility.—Because many of the soils in this county, particularly the light-colored ones, are naturally acid and low in content of plant nutrients, additions of lime and fertilizer are needed. Such additions should be based on the results of soil tests, on the need of the crop, and on the level of yields desired. For assistance in determining the kinds and amounts of fertilizer and lime to apply, farmers should consult the Ohio Agricultural Extension Service. Maintaining the organic-matter content of soils helps to insure good soil structure and tilth.

Utilization of crop residue.—Many of the soils in this county, particularly the light-colored ones, are not naturally high in organic-matter content. To offset this deficiency, all crop residue should be incorporated into the soil. If soybeans or other crops that produce little residue are grown, the cropping system should provide cover crops and sod crops.

Drainage.—In this county, wetness is a hazard on about 65 percent of the acreage suitable for cultivated crops. Crops grow well, however, on somewhat poorly drained, poorly drained, and very poorly drained soils where excess water has been removed by surface drains, tile, or both. Land smoothing is also beneficial in many areas. Few or no practices are needed for improving drainage on the moderately well drained soils.

Control of erosion.—In this county erosion is a hazard on gently sloping to very steep soils. About 34 percent of the acreage suitable for cultivation is susceptible to erosion. Practices of erosion control commonly used in the county are contour stripcropping, contour tillage, minimum tillage, constructing terraces, waterways, and diversions, utilizing crop residue, and planting close-growing crops.

[2] By Glen E. Bernath, State soil conservationist, and Richard L. Googins, assistant State soil scientist.

Capability groups of soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to other crops that have their special requirements. The soils are classified according to degree and kinds of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils, and without consideration of possible major reclamation projects.

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

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

- Class I soils have few limitations that restrict their use.
- Class II soils have some limitations that reduce the choice of plants or 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 restrict the choice of plants, require very careful management, or both.
- Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover. (No class V soils were mapped in Delaware County.)
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife food and cover.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (No class VIII soils were mapped in Delaware County.)

Capability Subclasses are soil groups within one capability 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 has been mostly 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 Delaware 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 subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, woodland, wildlife, 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, IIe–2 or IIIe–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass or kind of limitation. The Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

The soils in Delaware County have been placed in 23 capability units. The soils in each unit have about the same limitations, are subject to similar risks of damage, need about the same kind of management, and respond to management in about the same way. In the following pages each capability unit is described and management of the soils in each unit is discussed. The mention of the soil series in the description of each capability unit does not mean that all the soils of the series mapped in this county are in the unit. To determine the soils in a capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

In the discussions of the capability units improved and optimum levels of management are mentioned for cropland and pasture. These levels of management are defined in the section "Estimated Yields."

The depth of the root zone refers to the depth of soil to a high water table or bedrock or to a layer of dense clay, compact till, or other material that restricts the growth of roots.

These descriptions also point out soil features that limit the use of soils for crops or pasture. Only general recommendations for overcoming the limitations are given. Erosion control or drainage, for example, can be achieved by many methods or combinations of practices on any given field of any kind of soil. For specific information regarding erosion control, artificial drainage, recommended crop varieties, or other management practices, the reader is urged to contact the nearest Soil Conservation Service Office or the Ohio Agricultural Extension Service.

CAPABILITY UNIT I–1

This capability unit consists of light-colored, level or nearly level, well drained or moderately well drained soils that have a silt loam surface layer. These soils are in the Ockley and Thackery series. They occupy stream terraces that generally are above the level of floods, but these soils are subject to occasional flooding in some areas. Sand and gravel are at a depth of 40 inches or more.

These soils have a deep root zone. Permeability is moderate, and available moisture capacity is high.

The soils in this unit are suited to the field crops and hay and pasture plants commonly grown in the county and to adapted special crops. If management is optimum, row crops can be grown year after year. Erosion is not likely on these soils if management is good. Soil structure can be maintained by using crops that produce large amounts of residue. If soybeans or other crops that produce small amounts of residue are grown, cover crops or sod crops should be included in the cropping system. These soils are well suited to irrigation.

CAPABILITY UNIT IIe–1

This unit consists of light-colored, gently sloping, well-drained soils of the Fox series that have a loam or silt loam surface layer. These soils lie on stream terraces that normally are above flood stage. They are mostly moderately deep to gravel and sand. Some areas are moderately eroded. In most places these soils occupy short slopes. These soils have a moderately deep root zone in most places. Available moisture capacity is low to medium. Permeability is moderate.

This group of soils is suited to the common field crops, to hay and pasture plants, and to the special crops commonly grown in the county. Because not enough moisture is available to plants late in the growing period, crops that mature early are better suited than those that mature late in summer. If management is optimum, row crops can be grown year after year on slopes of 4 percent or less; areas having slopes of as much as 6 percent can be row cropped frequently.

Where management is less than optimum, soil losses through erosion are likely to be excessive, for erosion is the principal limitation to use of these soils. Locally, where depth to sand or gravel is less than 30 inches, these soils tend to be droughty, but they are well suited to irrigation. In frequently cultivated areas, particularly where the soils have a silt loam surface layer, crop residue should be returned to the soil so that soil structure does not deteriorate. In hay meadows and pastures, erosion is controlled by insuring that the plant cover is adequate for protection.

CAPABILITY UNIT IIe–2

This capability unit consists of light-colored, gently sloping, well drained or moderately well drained soils on uplands and terraces. These soils are in the Cardington, Loudonville, Milton, Morley, Ockley, and Thackery series. They have a silt loam surface layer. The Cardington and Morley soils are underlain by glacial till. The Thackery soils and most of the Ockley soils are underlain by sand and gravel. Sandstone underlies the Loudonville soils, and limestone underlies the Milton soils. Some areas of the soils in this unit are moderately eroded.

These soils have a moderately deep or deep root zone. Permeability is moderate or moderately slow. Available moisture capacity is medium to high except in areas of Loudonville soils. The Loudonville soils have low available moisture capacity.

Erosion is the major limitation to the use of these soils. If cultivation is intensive, management is needed so that fertility and soil structure are maintained.

The soils in this unit are suited to the field crops, special crops, and hay and pasture plants commonly grown in the county. Areas having slopes of no more than 4 percent can be row cropped year after year if management is optimum. Where management is less than optimum, the cropping sequence should include a small grain or another close-growing crop, sod crops, and pasture plants to help maintain soil structure and control erosion. In pastures and hay meadows, an adequate plant cover is needed to control erosion.

CAPABILITY UNIT IIw-1

This capability unit consists of somewhat poorly drained and poorly drained soils that have a silt loam surface layer. These soils are in the Algiers and Shoals series. They occupy flood plains and are particularly subject to flooding in winter and spring.

These soils have a seasonal high water table. They are late in drying out in spring, even in drained areas. The root zone is deep, and available moisture capacity is high. Permeability is moderately slow in the Algiers soils and moderate in the Shoals soils.

The major limitation to use of these soils is wetness, but maintaining soil structure is also important. If these soils are worked or grazed when they are wet, they are compacted, soil structure breaks down, and tillage is more difficult. The water table can be lowered by installing tile drains where outlets are available. Surface wetness can be reduced by digging shallow ditches and by installing diversions at the base of adjacent slopes.

If these soils are adequately drained, they are suited to most of the field crops commonly grown in the county and to hay and pasture plants that withstand wetness. Because flooding is frequent in some local areas, use of these soils is limited to pasture or woodland. If management is optimum, row crops can be grown year after year in areas where the hazard of flooding is not so severe.

CAPABILITY UNIT IIw-2

This capability unit consists of dark-colored, nearly level soils that have a silty clay loam surface layer. These soils are in the Bonpas, Pewamo, and Westland series. They are in depressions and flats of the glacial till uplands and are on stream terraces.

These soils have a seasonal high water table. Undrained areas are slow to dry out in spring. In drained areas the root zone is deep. Available moisture capacity is high, and permeability is moderately slow. Because the content of organic matter is high in the surface layer, crusting is not likely. But these soils can be worked only within a narrow range of moisture content.

Very poor natural drainage and the resulting wetness are major limitations to use of these soils. Because of the moderately fine textured surface layer, these soils are easily compacted and made cloddy if they are tilled or grazed when wet.

Row crops can be grown frequently or year after year if drainage is adequate and if the level of management is optimum. Unless these soils are drained, they are not well suited to row crops, but they can be drained by tile. Drained areas are suited to the common field crops and to most of the common pasture plants and hay plants, including alfalfa. Undrained areas are suited only to those plants that tolerate wetness for long periods.

CAPABILITY UNIT IIw-3

This capability unit consists of light-colored, somewhat poorly drained, nearly level and gently sloping soils that have a silt loam surface layer. These soils are in the Bennington, Blount, McGary, Randolph, and Sleeth series. They are on uplands and stream terraces.

These soils have a moderately deep or deep root zone. Permeability is moderately slow or slow, and available moisture capacity is medium to high. Water saturates these soils for significant periods in winter and spring. Surface crusting is likely.

The use of these soils is limited mainly by poor natural drainage and wetness, but the soils can be artificially drained. All of these soils can be drained by tile, but installing tile drains in the Randolph soils is difficult because limestone bedrock underlies those soils at a depth of 20 to 40 inches. Drained areas are suited to most of the common field crops and to the hay and pasture plants commonly grown in the county.

If management is optimum, these soils can be cultivated frequently, even year after year. Crops that produce a large amount of residue should be used so as to maintain soil structure and tilth. The control of erosion should be stressed in the management of the gently sloping soils. Undrained areas are suited to most field crops and to hay and pasture plants that can withstand wetness. In these areas planting is generally delayed in spring, and crops do not grow well in wet years. In the gently sloping pastured areas, erosion is controlled by insuring that the plant cover is adequate for protection.

CAPABILITY UNIT IIw-4

This capability unit consists of well drained and moderately well drained soils that have a silt loam surface layer. These soils are in the Eel, Genesee, and Ross series. They occur along streams and are subject to flooding and deposition of sediments.

Except for the shallow variant of the Genesee series, these soils are deep and have a deep root zone. Permeability is moderate, and available moisture capacity is generally high. Surface crusting is common in areas where the content of organic matter is low. These soils are suited to irrigation.

This group of soils is suited to crops commonly grown in the county and to adapted hay and pasture plants. Row crops can be grown year after year under improved or optimum management, but yields are higher if management is optimum. Except in some of the low areas, row crops grown in summer are seldom damaged by flooding, but crops grown in spring may be frequently damaged. In low areas where flooding is frequent, trees or a permanent cover of grasses are better suited than cultivated crops.

CAPABILITY UNIT IIs-1

This capability unit consists of nearly level, well-drained soils that have a loam or silt loam surface layer. These soils are in the Fox and Milton series. They are underlain by sand, gravel, or limestone. The underlying material is at a depth of 20 to 40 inches.

These soils have a moderately deep root zone. Available moisture capacity is low to medium. Permeability is moderate to moderately slow. The silt loams are more likely to crust than the loams. These soils are suitable for irrigation, and the hazard of erosion is only slight.

The soils in this unit are suited to the crops commonly grown in the county, to adapted hay and pasture plants, and to adapted special crops. If management is optimum,

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row crops can be grown frequently, even year after year. Irrigation is generally needed in summer.

Conserving moisture is the main concern in managing these soils. If large amounts of crop residue are kept on the surface, more water enters the soil. Residue is particularly needed on the soil that has a silt loam surface layer. Crop residue also helps in maintaining soil structure.

CAPABILITY UNIT IIIe-1

The soils in this capability unit are well drained and moderately well drained and have a silt loam surface layer. They are in the Alexandria, Cardington, Morley, and Ockley series. These soils occur on uplands and terraces and are gently sloping and sloping. Some areas are moderately eroded.

These soils have a moderately deep or deep root zone. Available moisture capacity is medium to high.

The major limitation to the use of these soils is the hazard of erosion. Maintaining fertility and the content of organic matter are also concerns. In addition, these soils are susceptible to surface crusting.

The soils in this unit are suited to the crops commonly grown in the county and to adapted hay and pasture plants. Row crops can be grown frequently if erosion is controlled. In frequently cultivated areas, erosion is reduced by using optimum management that provides close-growing crops, grasses, legumes, and crops that produce large amounts of residue.

CAPABILITY UNIT IIIe-2

This capability unit consists of light-colored, well-drained, gently sloping to sloping soils on uplands. These soils are in the Loudonville, Milton, and Rarden series. They have a silt loam surface layer. The Loudonville soils are underlain by sandstone, the Rarden soils by shale, and the Milton soils by limestone. Milton soils are less acid throughout than are the Loudonville and Rarden soils. All of the soils are moderately eroded.

These soils have a moderately deep root zone and low to medium available moisture capacity. As a result, they tend to be droughty. Permeability is slow in the Rarden soils, moderately slow in the Milton, and moderate in the Loudonville.

The soils in this unit are suited to most field crops and to the hay and pasture plants commonly grown in the county. They are not well suited to special crops unless management is optimum or very intensive. Optimum management for field crops provides close-growing crops, grasses, and legumes.

A severe hazard of erosion is the primary limitation to the use of these soils, but maintaining fertility, soil structure, and organic-matter content are also concerns in frequently cultivated areas. Crop residue should be returned to the soil so that soil structure does not deteriorate. In hay meadows and pastures, erosion is controlled by maintaining an adequate plant cover for protection.

CAPABILITY UNIT IIIe-3

This capability unit consists of sloping, well-drained Fox soils that have a silt loam surface layer. These soils are moderately deep to sand and gravel. They occur on stream terraces, and some areas on terrace breaks are subject to occasional flooding. Some areas are moderately eroded, and in most areas the slopes are short.

These soils have a moderate capacity for storing plant nutrients, and they are easy to cultivate. Permeability is moderate, and available moisture capacity is medium to low. These soils tend to be droughty in dry periods, but they are suited to irrigation.

The hazard of erosion is the main limitation to the use of these soils. Use for row crops is limited, but most row crops grown in the county are suited. Also suited are hay and pasture plants. Because these soils tend to be droughty, crops that mature early are better suited than crops that mature late in summer unless irrigation is provided. If row crops are grown, they should be grown in a sequence that provides close-growing crops. Returning large amounts of residue to these soils is necessary for maintaining moisture and soil structure. Needed for the control of erosion are close-growing crops, grasses, legumes, and crops that produce large amounts of residue.

CAPABILITY UNIT IIIe-4

Ritchey silt loam, 2 to 6 percent slopes, is the only soil in this capability unit. This soil is well drained and shallow to limestone. It is on uplands.

This soil has a shallow root zone. Available moisture capacity is low, and permeability is moderately slow.

This soil is suited to field crops commonly grown in the county. Because of droughtiness, small grain and other crops that mature early are better suited than crops that mature late in summer. Hay and pasture plants are also suited, but they do not grow well in dry periods. A cropping system is needed that provides small grain and grasses or legumes.

The hazard of erosion is the main limitation to use of this soil. Other concerns of management are maintaining a high level of fertility and a high content of organic matter.

CAPABILITY UNIT IIIw-1

Willette muck is the only soil in this capability unit. This soil occupies level and basinlike areas and is very poorly drained.

Very poor drainage is the main limitation to use of this soil, but crops grow well in drained areas. Root penetration is moderately deep or deep in drained areas or in midsummer when the water table is low. Available moisture capacity is high. Soil blowing is likely in drained, bare areas.

Drained areas of this soil are suited to the field crops commonly grown in the county and to adapted special crops. If management is optimum, crops can be cultivated year after year. Tile or surface drains can be used for drainage. Subsidence of the muck is controlled by controlling the water table. Because this organic soil dries out in drained areas, irrigation may be needed. Irrigation helps to control soil blowing. Undrained areas are swampy and are not suited to cultivated crops.

This soil can be used for hay or pasture. Permanent pasture is suitable in areas that cannot be drained, or in areas that are subject to frequent flooding or ponding, but grazing should be limited to dry periods.

Willette muck is poorly suited as woodland, but adapted plants can be grown to improve it as a habitat for wildlife.

CAPABILITY UNIT IIIw-2

Condit silt loam, 0 to 2 percent slopes, is the only soil in this capability unit. It is light colored, poorly drained, and nearly level or depressional. It receives runoff from surrounding areas.

This soil has a moderately deep root zone in most places. Available moisture capacity is high, and permeability is slow.

The major limitation to use of this soil is wetness, which makes good soil structure and tilth difficult to maintain. Because permeability is slow, drainage by tile is slow and some tiled areas remain wet.

This soil is suited to field crops commonly grown in the county and to hay and pasture plants that can withstand wetness. It is poorly suited to special crops. Suitable crops grow better where excess water has been removed by ditches. Areas that are difficult to drain can be planted to permanent pasture.

CAPABILITY UNIT IIIw-3

Only Millsdale silty clay loam is in this capability unit. This nearly level soil occurs on uplands. It is dark colored, very poorly drained, and 20 to 40 inches deep to limestone.

This soil has a moderately deep root zone. Available moisture capacity is medium, but seepage from adjacent soils provides additional water for crops. Permeability is moderately slow. This soil can be worked only within a relatively narrow range of moisture content.

Poor drainage is the principal limitation to use of this soil. In addition to drainage, practices are needed to maintain soil structure and tilth. Tile or surface drains can be used for drainage, but in some places bedrock interferes with the installation of tile.

Drained areas of this soil are suited to crops generally grown in the county. If management is optimum, crops can be grown year after year. Undrained areas are late in drying out in spring and generally are not cultivated. Grasses and legumes that can withstand wetness are suitable for hay and pasture.

CAPABILITY UNIT IIIw-4

Sloan silty clay loam is the only soil in this capability unit. It is dark colored, nearly level, and very poorly drained. It lies along streams and is subject to flooding, particularly in winter and spring.

This soil has a deep root zone when the water table is low. Available moisture capacity is high, and permeability is moderately slow.

Use of this soil is limited mainly by very poor natural drainage and a high water table. Undrained areas are too wet for cultivated crops, but drained areas are suited to the row crops commonly grown in the county (fig. 3). If management is optimum, row crops can be grown year after year. Summer crops are seldom damaged by flooding, though damage to winter wheat is likely. Water-tolerant pasture plants can be grown on this soil, but pasture grows better in drained areas. Tile or surface drains can be used for drainage, and diversions are beneficial where runoff from higher areas is a hazard.

CAPABILITY UNIT IVe-1

This capability unit consists of sloping, well-drained soils that have a silt loam surface layer. These soils are in the Alexandria, Fox, Milton, Morley, and Ockley series. They occur on uplands and terraces. Most areas are moderately eroded.

***Figure 3.*—Corn and soybeans on Sloan silty clay loam. This soil is in capability unit IIIw-4.**

These soils have a moderately deep or deep root zone and, in most places, medium available moisture capacity. Permeability is moderate or moderately slow. Surface crusting is likely.

Erosion is the main limitation to use of this soil, and its control is of primary importance. Also needed are practices that help to maintain good tilth and a high level of fertility.

The soils in the unit are suited to the field crops commonly grown in the county and to adapted hay and pasture plants. Cultivated crops can be grown at infrequent intervals if management is optimum. Grasses and legumes should be grown most of the time so as help control erosion.

CAPABILITY UNIT IVe-2

Ritchey silt loam, 6 to 12 percent slopes, moderately eroded, is the only soil in this capability unit. It occurs on uplands and is well drained and shallow to limestone.

This soil has a shallow root zone. Available moisture capacity is low, and permeability is moderately slow.

Erosion is the main limitation to use of this soil, and its control is of primary importance. Another limitation is droughtiness.

This soil is suited to the field crops commonly grown in the county and to adapted hay and pasture plants. Close-growing crops, grasses, and legumes should be grown most of the time. Because available moisture is limited, winter grain and forage crops are better suited than row crops. Grasses and legumes do not grow well in dry periods.

CAPABILITY UNIT IVe-3

This capability unit consists of sloping, well drained and moderately well drained soils that have a silty clay loam, clay loam, or silt loam surface layer. These soils are in the Alexandria, Morley, and Rarden series. They are on uplands and are moderately eroded or severely eroded.

These soils have a moderately deep root zone. Available moisture capacity is medium, and permeability is moderately slow or slow. These soils contain little organic matter and are difficult to till. They can be worked only within a narrow range of moisture content.

The soils of this unit are suited to the field crops commonly grown in the county and to adapted hay and pasture plants. A row crop can be grown occasionally, provided management is optimum and close-growing crops, grasses, and legumes are grown most of the time.

Management is needed that controls erosion, improves soil structure, increases the intake of water, and maintains fertility. An important practice is growing crops that produce large amounts of residue and returning the residue to the soil.

CAPABILITY UNIT VIe-1

In this capability unit are moderately steep and steep soils on uplands. These soils are in the Alexandria, Morley, and Rarden series. Except for the Rarden soil, which is underlain by acid shale, these soils are underlain by glacial till.

These soils have a moderately deep root zone. Permeability is moderately slow or slow, and available moisture capacity is medium.

Because the soils of this unit are moderately steep and steep, are eroded, and are highly susceptible to further erosion, they are not suited to cultivation. They are suited to adapted grasses and legumes grown for permanent pasture and hay. Erosion is a severe hazard when pastures are reseeded and when adequate cover is not maintained. It is essential that grazing is controlled and that fertility is maintained.

CAPABILITY UNIT VIe-2

This capability unit consists of well-drained, moderately steep to steep, moderately eroded soils that have a loam and silt loam surface layer. These soils are in the Casco, Fox, and Ritchey series. They occur on uplands and terraces. The Ritchey soil is shallow to bedrock; the Casco soil is shallow to limy sand and gravel; and the Fox soil is moderately deep to limy sand and gravel.

Water moves more slowly through the Ritchey soil than through the Casco or the Fox. These soils have low available moisture capacity and in most places a shallow root zone.

The soils of this unit are suited to adapted grasses and legumes grown for hay and pasture. They are too steep and susceptible to erosion for cultivation. The steepest slopes are suited only to native pasture. An adequate protective cover is essential on these soils.

CAPABILITY UNIT VIIe-1

This capability unit consists of very steep soils in the Alexandria, Loudonville, and Rarden series. These soils have a moderately deep root zone and medium to low available moisture capacity. They are droughty in summer.

The soils of this unit are not suited to cultivated crops. Their suitability for improved pasture is limited by the steep slopes and the difficulty in renovating and reseeding the pasture. Management is needed that provides protective ground cover to help control erosion. These soils have some limitations as commercial woodland, but adapted trees can be planted for the control of erosion.

CAPABILITY UNIT VIIs-1

Only Colyer silt loam, 25 to 50 percent slopes, and Rock land, limestone, steep, are in this capability unit. This soil and land type are shallow and droughty. Available moisture capacity is low to very low.

This soil and land type are better suited to permanent native pasture and trees than to other uses. Their use for pasture is limited in dry periods, and their suitability for commercial woodland is poor. Adapted trees, however, and other vegetation can be planted to help control erosion.

Estimated yields

Table 1 shows, for most soils in the county, the estimated average acre yields of principal crops. The yields are the averages of those expected over a period of several years under two levels of management. The Alexandria, Morley, Loudonville, Rarden, and Colyer soils that have slopes of more than 25 percent are not listed in table 1, because they are not suited to crops. Also excluded from table 1 are the land types Borrow pit, Gravel pit, Made land, Marsh, Quarry, and Rock land, limestone, steep.

In table 1, yields in columns A are obtained under improved management, and those in columns B are obtained under optimum management. Under an optimum level of management—

1. Practices are used that increase the intake of water and the water-holding capacity of the soils. Excess water is disposed of by appropriate means.
2. Practices are used to help control erosion.
3. Suitable methods of plowing, preparing the seedbed, and cultivation are used.
4. Weeds, diseases, and insects are controlled.
5. Fertility is maintained at the highest level. Lime and fertilizer are applied according to needs of the soil and crop. The fertilizer contains trace elements (zinc, cobalt, manganese, copper, and the like) if they are needed.
6. Crop varieties that are suited to the soil are selected.
7. All farming operations are done at the proper time and in the proper way.

In an improved level of management the farmer uses some, but not all, of the practices listed under optimum management, or the practices used are not adequate for the needs of the crop.

The yields given in table 1 do not apply to a specific field for any particular year, because the soils vary from place to place, management practices vary from farm to farm, and weather conditions are variable from year to year.

These yields are intended only as a guide that shows relative productivity of the soils, the response of soils to management, and the relationship of soils to each other. Although the general level of crop yields may change as new methods and new crop varieties are developed, the relationship of the soils to each other is not likely to change.

The estimates of yields given in table 1 are based primarily on information obtained from farmers and on observations and field trials made by the county agent and work unit conservationists of the Soil Conservation Service. They are also based on experiments made by the Ohio Agricultural Research and Development Center and on field observations made by members of the soil survey party.

Table 1.—*Estimated average acre yields of the principal crops under two levels of management*

[Yields in columns A are to be expected under an improved level of management; those in columns B, under an optimum level of management. Absence of yield indicates that crops are not commonly grown at that level of management, or that the soil is not suited to the crop specified]

Soil	Corn		Oats		Wheat		Soybeans		Legume-grass hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Alexandria silt loam, 6 to 12 percent slopes	50	80	41	58	25	36	18	27	2.5	3.7
Alexandria silt loam, 6 to 12 percent slopes, moderately eroded	40	70	32	------	22	30	17	23	1.9	3.0
Alexandria silt loam, 12 to 18 percent slopes	45	70	34	50	24	32	16	26	1.9	3.0
Alexandria silt loam, 12 to 18 percent slopes, moderately eroded	40	65	34	50	18	26	16	24	1.9	3.0
Alexandria silt loam, 18 to 25 percent slopes	------	------	------	------	------	------	------	------	1.7	2.8
Alexandria silt loam, 18 to 25 percent slopes, moderately eroded	------	------	------	------	------	------	------	------	1.5	2.5
Alexandria soils, 6 to 12 percent slopes, severely eroded	------	------	------	------	------	------	------	------	1.5	2.5
Alexandria soils, 12 to 25 percent slopes, severely eroded	------	------	------	------	------	------	------	------	1.5	2.5
Algiers silt loam	75	120	48	60	20	38	26	36	2.5	4.5
Bennington silt loam, 0 to 2 percent slopes	58	97	40	66	22	35	22	34	2.0	3.4
Bennington silt loam, 2 to 6 percent slopes	55	94	40	69	24	33	22	34	2.0	3.4
Bennington silt loam, 2 to 6 percent slopes, moderately eroded	51	89	38	62	20	32	16	26	1.7	2.9
Bennington silt loam, shale substratum, 0 to 2 percent slopes	50	95	36	70	23	34	22	35	1.7	3.3
Bennington silt loam, shale substratum, 2 to 6 percent slopes	48	90	35	65	19	33	17	30	2.2	3.3
Blount silt loam, 0 to 2 percent slopes	60	98	42	66	22	36	22	34	2.0	3.4
Blount silt loam, 2 to 6 percent slopes	56	95	42	70	24	34	22	34	2.0	3.4
Bonpas silty clay loam	80	115	48	78	25	38	28	40	3.0	4.5
Cardington silt loam, 2 to 6 percent slopes	57	92	42	72	22	37	24	34	2.6	3.4
Cardington silt loam, 2 to 6 percent slopes, moderately eroded	55	86	40	68	21	35	20	30	2.4	3.2
Cardington silt loam, 6 to 12 percent slopes	55	86	42	70	20	34	20	30	2.6	3.4
Cardington silt loam, 6 to 12 percent slopes, moderately eroded	50	80	35	60	17	28	16	28	2.3	3.2
Casco-Fox loams, 12 to 25 percent slopes, moderately eroded	------	------	------	------	------	------	------	------	1.0	2.0
Condit silt loam, 0 to 2 percent slopes	36	77	28	45	11	25	13	28	1.4	2.6
Eel silt loam	90	120	54	75	30	40	32	38	3.5	4.5
Fox silt loam, 0 to 2 percent slopes	58	95	50	76	27	39	24	32	2.7	3.5
Fox silt loam, 2 to 6 percent slopes	52	95	45	74	27	38	22	32	2.4	3.4
Fox silt loam, 2 to 6 percent slopes, moderately eroded	50	90	42	70	24	36	20	30	2.2	3.4
Fox silt loam, 6 to 12 percent slopes	51	85	43	72	25	37	18	26	2.4	3.4
Fox silt loam, 6 to 12 percent slopes, moderately eroded	50	80	40	69	22	34	18	26	2.1	3.2
Fox silt loam, 12 to 18 percent slopes, moderately eroded	40	70	30	56	16	22	16	22	1.8	3.0
Fox loam, 0 to 2 percent slopes	58	95	50	76	27	38	24	32	2.7	3.5
Fox loam, 2 to 6 percent slopes	52	95	45	75	27	37	22	32	2.3	3.5
Genesee silt loam	90	125	54	78	34	40	32	38	3.1	4.5
Genesee silt loam, shallow variant	68	80	44	65	21	40	19	26	2.6	4.5
Loudonville silt loam, 2 to 6 percent slopes	65	95	56	75	26	40	24	35	3.2	4.2
Loudonville silt loam, 6 to 12 percent slopes, moderately eroded	60	88	45	65	22	36	20	26	3.0	4.0
McGary silt loam, 0 to 2 percent slopes	70	96	45	75	27	40	22	34	2.0	4.0
Millsdale silty clay loam	65	105	48	76	24	38	24	38	2.6	4.0
Milton silt loam, 0 to 2 percent slopes	55	90	46	70	26	38	22	32	2.2	3.2
Milton silt loam, 2 to 6 percent slopes	55	85	44	70	24	38	22	30	2.2	3.2
Milton silt loam, 2 to 6 percent slopes, moderately eroded	40	75	38	54	22	34	16	24	2.0	3.0
Milton silt loam, 6 to 12 percent slopes, moderately eroded	35	60	32	------	21	30	12	20	1.4	2.6
Milton silt loam, 12 to 18 percent slopes, moderately eroded	30	50	30	------	18	26	10	18	1.2	2.2
Morley silt loam, 2 to 6 percent slopes	62	95	45	78	28	40	22	34	2.8	3.8
Morley silt loam, 2 to 6 percent slopes, moderately eroded	60	90	42	72	25	35	24	34	2.5	3.6
Morley silt loam, 6 to 12 percent slopes	55	85	41	65	24	36	18	30	2.7	3.7
Morley silt loam, 6 to 12 percent slopes, moderately eroded	53	80	38	58	21	35	16	28	2.3	3.2
Morley silt loam, 12 to 18 percent slopes	45	65	35	54	20	30	15	25	2.3	3.2
Morley silt loam, 12 to 18 percent slopes, moderately eroded	45	60	32	50	20	28	10	20	2.0	3.0
Morley silt loam, 18 to 25 percent slopes, moderately eroded	------	------	------	------	------	------	------	------	1.8	2.6
Morley soils, 6 to 12 percent slopes, severely eroded	------	------	------	------	------	------	------	------	2.0	3.0
Morley soils, 12 to 18 percent slopes, severely eroded	------	------	------	------	------	------	------	------	1.8	2.6
Ockley silt loam, 0 to 2 percent slopes	67	105	50	76	28	44	26	34	2.6	4.0
Ockley silt loam, 2 to 6 percent slopes	66	105	50	74	28	42	24	34	2.6	4.0
Ockley silt loam, 2 to 6 percent slopes, moderately eroded	63	100	42	70	23	38	24	30	2.2	3.9
Ockley silt loam, 6 to 12 percent slopes	60	95	42	66	22	32	23	28	2.0	3.6
Ockley silt loam, 6 to 12 percent slopes, moderately eroded	57	90	40	65	22	30	20	26	2.0	3.6
Ockley silt loam, 12 to 18 percent slopes, moderately eroded	50	85	35	60	18	26	18	22	1.8	3.0
Ockley silt loam, till substratum, 2 to 6 percent slopes	66	105	50	74	28	42	24	34	2.6	4.0
Pewamo silty clay loam	80	115	48	80	28	42	24	34	2.6	4.0
Randolph silt loam, 0 to 2 percent slopes	40	75	36	64	20	32	20	32	1.8	3.3
Rarden silt loam, 2 to 6 percent slopes, moderately eroded	56	90	50	70	24	36	20	30	3.0	4.0
Rarden silt loam, 6 to 12 percent slopes, moderately eroded	50	80	38	57	21	30	17	24	2.5	3.3
Rarden silt loam, 12 to 25 percent slopes	------	------	------	------	------	------	------	------	2.0	2.8
Ritchey silt loam, 2 to 6 percent slopes	50	75	40	65	22	30	20	28	2.0	2.8

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

Soil	Corn		Oats		Wheat		Soybeans		Legume-grass hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Ritchey silt loam, 6 to 12 percent slopes, moderately eroded	40	65	35	55	18	26	14	22	1. 5	2. 4
Ritchey silt loam, 12 to 25 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	1. 0	1. 8
Ross silt loam	90	125	54	78	34	40	32	38	2. 0	2. 8
Shoals silt loam	65	105	46	70	24	38	28	34	2. 3	3. 4
Sleeth silt loam, 0 to 2 percent slopes	60	100	44	68	24	36	26	34	2. 3	3. 4
Sleeth silt loam, 2 to 6 percent slopes	60	97	44	65	22	34	20	30	2. 1	3. 1
Sloan silty clay loam	70	100	40	75	22	35	26	34	2. 7	4. 2
Thackery silt loam, 0 to 2 percent slopes	64	100	45	76	28	42	24	30	2. 7	4. 1
Thackery silt loam, 2 to 6 percent slopes	62	100	45	76	26	40	22	28	2. 7	4. 0
Westland silty clay loam	80	115	46	78	24	38	26	38	2. 8	4. 2
Willette muck	75	110	----	----	----	----	----	----	----	----

Woodland [3]

A dense forest covered Delaware County when it was first settled, but in 1964, according to the U.S. Census of Agriculture, woodland occupied about 17,462 acres, or less than 7 percent of the total land area. At the present time, woodland occurs as widely scattered, small woodlots and, because of mismanagement, production is below the capacity of the individual soils.

Generally, remnants of the original forest occupy small areas of soils that are least suited to other crops. These trees are generally in undrained areas of Blount, Bennington, Condit, Pewamo, Bonpas, and other seasonally wet soils. Wooded tracts are also in areas of steep, shallow soils, such as the Rarden, Morley, Ritchey, and Colyer and in areas of Loudonville silt loam, shallow variant.

The potential of a soil for producing forest trees is measured by the site index. The site index is the average height, in feet, of the dominant trees in a stand at 50 years of age. Information about the potential productivity of the soils in this county is limited. To date, studies of site indexes have been made on only a few soils to determine their value for growing trees. The areas studied were in Delaware County and in adjacent counties. The site index and the potential annual growth for upland oaks given in table 2 were based on these studies and on data from the USDA Technical Bulletin No. 560 (*7*).[4]

More specific information about managing woodland in this county can be obtained from the local office of the Soil Conservation Service and from the Ohio Department of Natural Resources, Division of Forestry and Reclamation.

TABLE 2.—*Potential productivity of upland oaks on specified soils*

Soil series	Plot	Site index	Estimated average yearly growth per acre
	Number		*Board feet*
Alexandria	2	80	320
Blount	3	70	230
Colyer	5	[1] 55–75	[1] 130–265
Condit	1	90	430
Loudonville	1	80	320
Morley	2	80	320
Rarden	42	[1] 55–75	[1] 130–265

[1] Dry or moist sites.

Use of Soils for Wildlife and Fish

Wildlife is an important natural resource in Delaware County, and the development of wildlife habitat fits in well with other agricultural uses of the soils. Since the early days of settlement, and the clearing of the land, the wildlife in the county has changed in kinds, distribution, and numbers. Because of these changes in land use, and the resulting changes in wildlife distribution, it is difficult to correlate the kinds and numbers of wildlife with specific soils.

Soil properties such as slope, productivity potential, texture, drainage, and effective depth influence the use of the soils. These factors, along with factors of topography, largely control the amount of food, water, and cover available for wildlife and the kinds and numbers of wildlife in any area. Wildlife that are common in Delaware County include pheasants, rabbits, quail, deer, waterfowl, and squirrels. Also numerous are skunks, raccoons, and opossums. Birds are also numerous in the county, and many of them are important because they eat harmful insects and also have esthetic value.

Generally, the largest number of each kind of wildlife frequent areas that provide enough of the kind of food and cover necessary for their survival. Pheasants prefer areas that are intensively cropped, and they are most numerous in the western two-thirds of the county in areas of Morley, Blount, and Pewamo soils. Waterfowl are abundant in the county during spring and fall migration because of the many drainageways and the O'Shaughnessy Reservoir on the Scioto River, the Delaware Reservoir on the Olentangy River, and the Hoover Reservoir on Big Walnut Creek. These reservoirs also furnish good fishing for bluegill, bass, catfish, and other species. The Division of Wildlife, Ohio Department of Natural Resources, maintains an area adjacent to the Delaware Reservoir for wildlife management.

[3] By A. NORRIS QUAM, woodland conservationist, Soil Conservation Service.

[4] Italic numbers in parentheses refer to Literature Cited, p. 70.

Suitability of soils for wildlife

In table 3 the soils and land types in the county, except Made land, are rated according to their suitability for elements of wildlife habitat and for kinds of wildlife. The natural drainage of the soils was one criterion used for the ratings given in the table. Soils that have been artificially drained have different ratings than those given in table 3. The information given in table 3 is useful in planning the development of wildlife habitat on private or public lands.

Additional information about managing wildlife areas can be obtained by requesting it from the local office of the Soil Conservation Service of the Division of Wildlife, Ohio Department of Natural Resources.

In table 3 numbers indicate ratings as follows: 1, well suited; 2, suited; 3, poorly suited; and 4, unsuited. A rating of *well suited* means that the soil has few or no limitations to use as the element of wildlife habitat. A rating of *suited* indicates that the habitat element can be created, improved, or maintained, but that there are moderate limitations that affect management. *Poorly suited* means that the habitat element can be created, improved, or maintained, but that limitations are severe. A rating of *unsuited* indicates that the habitat cannot be created, improved, or maintained, or that it is impractical to do so under the prevailing conditions.

The following lists important plants or describes each of the elements of wildlife habitat related in table 3(*1*).

Grain and seed crops. Corn, sorghum, oats, barley, rye, and wheat.

Grasses and legumes. Alfalfa, Ladino clover, red clover, fescue, bromegrass, bluegrass, and timothy.

Wild herbaceous upland plants. Foxtail, ragweed, panicgrass, wild oats, native lespedeza, and herbs.

Hardwood woody plants. Trees and shrubs such as sumac, wild grape, dogwood, persimmon, multiflora rose, black haw, sweetgum, wild cherry, oak, hickory, and walnut. In table 3, the soils are rated on the basis of their capacity for supporting plants that grow vigorously and produce a good crop of fruit or seeds.

Coniferous woody plants. Eastern redcedar, Virginia pine, Scotch pine, and Austrian pine. In table 3, the soils are rated on the basis of slow growth and delayed canopy closure.

Wetland food and cover plants. Cattails, sedges, reeds, barnyard grass, duckweed, and various willows.

Shallow water developments. These are areas that have been made by impounding water, by digging excavations, or by using devices to control water. In table 3, the soils are rated on the basis of their suitability for water developments that are more than 5 feet deep.

Excavated ponds. These are excavations that hold enough water of suitable quality to support fish or wildlife. The ponds should have an average depth of at least 6 feet in at least one-fourth of the area.

The following lists important animals and birds in each of the three categories of wildlife listed in table 3.

Openland wildlife. Quail, pheasants, meadow larks, cottontail rabbits, red foxes, and woodchucks.

Woodland wildlife. Birds and mammals commonly found in wooded areas. Examples are: gray and fox squirrels, whitetail deer, red foxes, raccoons, woodchucks, warblers, woodpeckers, and buntings.

Wetland wildlife. Muskrats and beavers, as well as ducks, geese, rails, herons, and other waterfowl.

Engineering Uses of Soils[5]

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, structures for erosion control, drainage systems, and sewage disposal systems. The soil properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and pH. Depth to water table, depth to bedrock, and topography also are important. The information in this survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing sites for light industry, businesses, residences, and recreation.
2. Make preliminary estimates of the engineering properties of soils that help in planning farm ponds, agricultural drainage systems, irrigation systems, terraces and diversions, and waterways.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
4. Locate probable sources of sand and gravel and other material suitable for construction.
5. Correlate performance of engineering structures with soil mapping units, and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

With the soil map for identification, the engineering interpretations in this section can be useful for many purposes. It should be emphasized, however, that the interpretations do not eliminate the need for sampling and testing at the site of specific engineering works where loads are heavy and where the excavations are deeper than here reported. Even in these situations, however, 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 not be familiar to the engineer, and some terms may have a special meaning in soil science. Several of these terms are defined in the Glossary at the back of this survey.

[5] Reviewed by LLOYD E. GILLOGLY, construction engineer, State Office of Soil Conservation Service.

TABLE 3.—*Suitability of soils for elements of wildlife habitat and for kinds of wildlife*

[A rating of 1 denotes well suited; 2 denotes suited; 3 denotes poorly suited; and 4 denotes unsuited. Made land (Ma) is not rated]

Soil series and map symbol	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Alexandria:											
AdC, AdC2	2	1	1	1	3	4	4	4	1	1	4
AdD, AdD2	3	2	1	1	3	4	4	4	2	2	4
AdE, AdE2	3	2	1	1	3	4	4	4	2	2	4
AeC3, AeE3	4	2	2	2	3	4	4	4	3	3	4
AmF2	4	3	2	2	3	4	4	4	3	3	4
Algiers:											
As	3	2	2	1	2	2	2	4	2	1	2
Bennington:											
BeA, BgA	2	2	2	2	3	2	2	2	2	2	2
BeB, BeB2, BgB	2	2	2	2	3	3	4	4	2	2	4
Blount:											
BlA	2	2	2	2	3	2	2	2	2	2	2
BlB	2	2	2	2	3	3	4	4	2	2	4
Bonpas:											
Bo	4	3	3	1	1	1	1	1	3	1	1
Borrow pit:											
Bp	4	4	3	3	1	(1)	(1)	(1)	4	3	(1)
Cardington:											
CaB, CaB2	2	1	1	1	3	4	4	4	1	1	4
CaC, CaC2	2	1	1	1	3	4	4	4	1	1	4
Casco:											
CfE2	3	2	2	2	2	4	4	4	2	2	4
Colyer:											
ClF	4	3	3	3	2	4	4	4	4	3	4
Condit:											
CnA	3	3	2	2	2	1	1	1	3	2	1
Eel:											
Ee	2	1	1	1	3	3	3	3	1	1	3
Fox:											
FlA, FnA	1	1	1	1	3	4	4	4	1	1	4
FlB, FnB, FnB2	2	1	1	1	3	4	4	4	1	1	4
FnC, FnC2	2	1	1	1	3	4	4	4	2	2	4
FnD2	3	2	1	1	3	4	4	4	2	2	4
CfE2	3	2	2	2	2	4	4	4	2	2	4
Genesee:											
Gn	1	1	1	1	3	4	4	4	1	1	4
Go	3	3	2	2	3	4	4	4	3	3	4
Gravel pit:											
Gp	4	4	4	4	1	4	4	4	4	4	4
Loudonville:											
LoB	2	1	1	1	3	4	4	4	1	1	4
LoC2	2	1	1	1	3	4	4	4	1	1	4
LsF	4	3	2	3	3	4	4	4	3	4	4
Marsh:											
Mc	4	4	4	4	4	1	1	1	4	4	1
McGary:											
MgA	2	2	1	1	3	2	2	2	1	2	2
Millsdale:											
Mn	3	3	3	1	1	1	1	3	3	1	1

See footnote at end of table.

TABLE 3.—*Suitability of soils for elements of wildlife habitat and for kinds of wildlife*—Continued

Soil series and map symbol	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Milton:											
MoA	2	1	1	1	3	4	4	4	1	1	4
MoB, MoB2	2	1	1	1	3	4	4	4	1	1	4
MoC2	2	1	1	1	3	4	4	4	1	1	4
MoD2	3	2	1	1	3	4	4	4	2	2	4
Morley:											
MrB, MrB2	2	1	1	1	3	3	3	3	1	1	3
MrC, MrC2	2	1	1	1	3	4	4	4	1	1	4
MrD, MrD2	3	2	1	1	3	4	4	4	2	2	4
MrE2	3	2	1	1	3	4	4	4	2	2	4
MsC3	3	2	2	2	3	4	4	4	2	3	4
MsD3	3	2	2	2	3	4	4	4	2	3	4
Ockley:											
OcA	1	1	1	1	3	4	4	4	1	1	4
OcB, OcB2, OsB	1	1	1	1	3	4	4	4	1	1	4
OcC, OcC2	2	1	1	1	3	4	4	4	1	1	4
OcD2	3	2	1	1	3	4	4	4	2	2	4
Pewamo:											
Pw	4	3	3	1	1	1	1	1	3	2	1
Quarry:											
Qu	4	4	4	4	3	4	4	4	4	4	4
Randolph:											
RaA	4	3	4	1	1	1	1	4	4	2	1
Rarden:											
RdB2	2	2	1	2	2	4	4	4	1	2	4
RdC2	2	2	1	2	2	4	4	4	1	2	4
RdE	3	2	2	2	3	4	4	4	2	2	4
RdF	4	3	2	2	3	4	4	4	3	2	4
Ritchey:											
RhB	3	3	2	2	3	4	4	4	3	3	4
RhC2	3	3	2	2	3	4	4	4	3	3	4
RhE2	3	3	2	2	3	4	4	4	3	3	4
Rockland:											
Rk	4	4	4	4	1	4	4	4	4	4	4
Ross:											
Rn	2	1	1	1	3	4	4	4	1	1	4
Shoals:											
Sh	2	2	1	1	3	2	2	3	1	2	2
Sleeth:											
SlA	2	2	1	1	3	2	2	4	1	2	3
SlB	2	2	1	1	3	3	4	4	1	2	4
Sloan:											
So	4	3	3	1	1	1	1	3	3	2	1
Thackery:											
ThA	1	1	1	1	3	3	3	3	1	1	3
ThB	2	1	1	1	3	3	3	3	1	1	3
Westland:											
Wu	4	3	3	1	1	1	1	3	3	1	2
Willette:											
Wv	4	4	4	4	4	1	1	1	2	4	1

[1] Rating ranges from well suited to poorly suited.

Much of the information in this section is given in tables 4, 5, and 6, but additional information useful to engineers can be found in other sections of the soil survey, particularly the sections "Descriptions of the Soils" and "Formation and Classification of Soils."

Engineering classification systems

Two systems of classifying soils are in general use among engineers. Both are used in this soil survey.

Many highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (AASHO) (*2*).

In this system, soil material is classified in seven principal groups. The groups range from A-1, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clayey soils having low strength when wet. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. They are shown in parentheses following the soil group symbol, as shown in table 4.

Some engineers prefer to use the Unified Soil Classification System (*10*). In this system soil material is identified as coarse grained (eight classes), fine grained (six classes), or highly organic soils. The classification of the tested

TABLE 4.—*Engineering test data for soil*

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

Soil name and location	Parent material	Ohio report No.	Depth	Horizon	Moisture-density [1]: Maximum dry density	Moisture-density [1]: Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
Bennington silt loam: SE¼ sec. 7, T 3 N., R. 16 W. (modal)	Glacial till (Wisconsin age).	8445	0–10	A	102	20
		8446	14–25	B2tg	103	21
		8447	32½–70	C	110	18
Blount silt loam: 0.1 mile east of township road T-276 and 30 feet south of township road T-219, SE¼ sec. 7, T. 5 N., R. 18 W. (modal for county).	Glacial till (Wisconsin age).	8454	0–9	Ap	102	20
		8455	14½–29	B2	102	20
		8456	29–52	C	119	13
Cardington silt loam: NE¼ sec. 21, T. 3 N., R. 18 W. (modal for county).	Glacial till (Wisconsin age).	8448	0–7	Ap	105	18
		8449	12–26½	B2	102	18
		8450	26½–51½	B3, C	117	15
Fox silt loam: NE¼ sec. 14, T. 6 N., R. 19 W. (modal for county).	Outwash sand and gravel (Wisconsin age).	8460	3½– 8½	A	107	18
		8461	8½–19	B, IIB	107	18
		8462	26–32½	IIB, IIC	127	10
Morley silt loam: 0.15 mile east of township road T-276 and 130 feet south of township road T-219, SE¼ sec. 7, T. 5 N., R. 18 W. (modal for county).	Glacial till (Wisconsin age).	8451	0–8	AP	102	20
		8452	12½–21½	B2	102	20
		8453	30–54	C	115	15
Pewamo silty clay loam: SE¼ sec. 7, T. 3 N., R. 16 W. (modal)	Glacial till (Wisconsin age).	8463	0–6½	AP	98	20
		8464	13–40½	B2g	104	19
		8465	74–95	C	114	16
0.12 mile east of township road T-276 and 470 feet south of township road T-219, SE¼ sec. 7, T. 5 N., R. 18 W. (modal for county).	Glacial till (Wisconsin age).	8457	0–7	Ap	95	24
		8458	12–33	B2g	105	19
		8459	33–50	C	117	14

[1] Based on AASHO Designation: T 99-57 Method A (*2*).

[2] Based on AASHO Designation: T 88 (*2*). Results by this procedure frequently 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 analyses data used in this table are not suitable for use in naming textural classes for soil.

soils according to the Unified system is given in table 4, and the estimated classification of all the soils is given in table 5.

Except for some relatively minor modifications, the classification system of the Ohio Department of Highways (see table 4) is identical to the AASHO classification system. In the Ohio system, an A–3a group designation is added, A–4 group is subdivided into A–4a and A–4b groups, and the A–6 group is subdivided into the A–6a and A–6b groups. Anyone using this system should consult the Ohio Department of Highways for a more detailed explanation of its soil classification system.

Soil test data

Samples from six soil types in the county were tested according to standard procedures to help evaluate the soils for engineering purposes. The test data obtained are given in table 4.

The engineering soil classifications given in table 4 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. Mechanical analyses were made by the combined sieve and hydrometer methods. The percentage of clay obtained by the hydrometer method should not be used in naming textural classes of soils.

samples taken from 7 soil profiles

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

Mechanical analysis [2]						Liquid limit	Plasticity index	Classification		
Percentage passing sieve—					Percentage smaller than—			AASHO [3]	Unified [4]	Ohio [5]
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.005 mm.					
100	96	93	89	79	40	[6] NP	[6] NP	A–4(8)	ML	A–4a
----	----	100	97	88	60	40	14	A–6(10)	ML–CL	A–6a
100	97	95	93	91	52	32	11	A–6(8)	CL	A–6a
----	----	100	95	85	57	34	6	A–4(8)	ML	A–4a
----	----	100	98	90	66	49	22	A–7–6(15)	ML–CL	A–7–6
100	97	93	88	78	43	30	12	A–6(9)	CL	A–6a
100	98	95	91	80	44	35	11	A–6(8)	ML–CL	A–6a
100	99	94	91	82	55	44	18	A–7–6(12)	ML–CL	A–7–6
100	94	86	79	70	37	29	11	A–6(7)	CL	A–6a
[7] 96	86	77	63	53	29	39	12	A–6(4)	ML–CL	A–6a
100	80	64	53	45	30	43	18	A–7–6(5)	SM–SC	A–7–6
[7] 93	56	32	17	11	5	NP	NP	A–1–a(0)	SW–SM	A–1–a
----	----	100	97	85	39	33	6	A–4(8)	ML	A–4a
100	97	93	90	81	53	40	16	A–6(10)	ML–CL	A–6b
100	97	92	87	77	44	29	11	A–6(8)	CL	A–6a
----	----	100	98	90	46	44	16	A–7–6(11)	ML–CL	A–7–6
----	----	100	98	92	55	52	31	A–7–6(18)	CH	A–7–6
100	92	81	76	66	42	33	11	A–6(7)	ML–CL	A–6a
----	----	100	98	90	46	45	12	A–7–5(10)	ML	A–7–5
----	----	100	97	87	50	37	13	A–6(9)	ML–CL	A–6a
100	95	89	84	74	42	34	13	A–6(9)	CL	A–6a

[3] Based on AASHO Designation: M 145–49 (*2*).
[4] Based on the Unified Soil Classification System, Technical Memorandum No. 3–357, v. 1, Corps of Engineers (*10*). SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A–line are to be given a borderline classification. An example of a borderline classification obtained by this use is ML–CL.
[5] Based on "Classification of Soils," Ohio State Highway Testing Laboratory, Feb. 1, 1955.
[6] Nonplastic.
[7] 100 percent passes a 1-inch sieve.

TABLE 5.—*Estimated*

[Absence of data indicates estimate was not made. Estimates were not made for

Soil series and map symbols	Depth to seasonal high water table	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Alexandria (AdC, AdC2, AdD, AdD2, AdE, AdE2, AeC3, AeE3, AmF2). (For properties of Morley soils in mapping unit AmF2, refer to the Morley series.)	>3	>5	0–7	Silt loam	ML	A–4
			7–19	Silty clay loam or clay loam	CL, CH	A–6
			19–45	Silty clay	CH	A–7
			45–60	Clay loam and loam	CL, ML–CL	A–6
Algiers (As)	<1	>5	0–9	Silt loam	ML	A–4
			9–19	Silty clay loam	ML, CL	A–4, A–6
			19–62	Silty clay loam, silty clay, or clay loam.	CL, CH	A–6, A–7
Bennington (BeA, BeB, BeB2)	<1. 5	>5	0–8	Silt loam	ML	A–4
			8–37	Silty clay or silty clay loam	CL, CH	A–6, A–7
			37–60	Loam or clay loam	ML–CL, CL	A–6
Bennington (shale substratum) (BgA, BgB).	<1. 5	>4	0–8	Silt loam	ML	A–4
			8–30	Silty clay or clay	CH	A–7
			30–48	Clay	CH	A–7
Blount (BlA, BlB)	<1. 5	>5	0–8	Silt loam	ML–CL	A–4
			8–29	Silty clay loam, clay, or silty clay.	CL–ML, CH	A–6, A–7
			29–60	Clay loam	CL	A–6
Bonpas (Bo)	<1	>5	0–9	Silty clay loam	CL	A–6, A–7
			9–43	Silty clay loam and clay loam	CH, CL	A–7, A–6
			43–60	Silty clay loam to sandy clay loam.	CL, SC	A–6, A–7
Cardington (CaB, CaB2, CaC, CaC2)	1–3	>5	0–7	Silt loam	ML–CL, ML	A–4, A–6
			7–29	Silty clay loam to clay	CL, CH, ML–CL	A–7, A–6
			29–63	Clay loam	CL	A–6
Casco (CfE2) (For properties of Fox soils in this mapping unit refer to the Fox series.)	>3	>5	0–7	Loam	ML	A–4
			7–17	Gravelly clay loam	CL	A–6
			17–60	Gravelly sand	SP, SM	A–2
Colyer (ClF)	>3	1. 5–2. 5	0–13	Silt loam and silty clay loam	ML, SM	A–4, A–2
			13–7	Shaly, silty clay loam or silty clay.	SC, SM	A2, A4, A6
			17–24	Shale.		
Condit (CnA)	0–1	>5	0–8	Silt loam	ML, CL	A–4, A–6
			8–45	Silty clay or silty clay loam	CL, CH	A–7
			45–63	Clay loam to silty clay loam	CL	A–6
Eel (Ee)	1. 5–3	>5	0–14	Silt loam	ML	A–4
			14–35	Loam or silty clay loam	ML, CL	A–4, A–6
			35–65	Fine sandy loam or loam	ML, SM	A–4
Fox (FlA, FlB, FnA, FnB, FnB2, FnC, FnC2, FnD2).	>4	>5	0–6	Loam or silt loam	ML, ML–CL	A–4, A–6
			6–30	Silty clay loam to gravelly clay loam.	CL, ML–CL	A–6, A–7
			30–60	Sand or gravel	GW, GM, SW, SM	A–1, A–2
Genesee (Gn)	0–3	>5	0–19	Silt loam	ML or CL	A–4 or A–6
			19–43	Silty clay loam	CL, ML	A–4, A–6
			43–54	Sandy clay loam	SM, ML, CL	A–4, A–6
Genesee (shallow variant) (Go)	>2	<2	0–8	Silt loam and silty clay loam	ML	A–4
			8–17	Fine sandy loam to sandy clay loam.	CL, ML	A–4, A–6
			17–24	Limestone.		

engineering properties of soils

Borrow pit (Bp), Gravel pit (Gp), Made land (Ma), Marsh (Mc), and Quarry (Qu)]

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					Steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
95–100	95–100	80–90	0. 2–2. 0	0. 17–0. 22	5. 1–5. 5	Low		Moderate.
95–100	95–100	85–95	0. 2–0. 63	0. 15–0. 18	4. 5–5. 0	Moderate	Moderate	Moderate to high.
95–100	95–100	75–90	0. 2–0. 63	0. 12–0. 16	5. 1–6. 0	Moderate	Moderate	Moderate.
95–100	85–95	70–85	0. 2–0. 63	0. 06–0. 10	(1)	Low	Low	Low.
100	95–100	75–90	0. 2–2. 0	0. 17–0. 23	6. 1–6. 5	Moderate		Low.
100	90–100	85–95	0. 63–2. 0	0. 15–0. 22	5. 6–6. 5	Moderate	High	Moderate.
90–100	85–100	70–90	0. 2–0. 63	0. 10–0. 20	6. 1–7. 3	Moderate	High	Low.
95–100	90–100	80–95	0. 63–2. 0	0. 16–0. 22	4. 5–5. 5	Low		Moderate to high.
100	100	85–95	0. 63–0. 2	0. 14–0. 18	5. 1–6. 6	Moderate	High	Moderate to low.
95–100	85–95	75–90	0. 63–0. 2	0. 06–0. 10	(1)	Moderate	High	Low.
100	95–100	80–95	0. 63–2. 0	0. 17–0. 22	4. 5–5. 5	Moderate		Moderate to high.
100	100	85–95	0. 02–0. 63	0. 12–0. 16	5. 2–6. 2	High	High	Moderate.
100	100	80–95	<0. 02	0. 08–0. 12	6. 0–7. 0	High	High	Low.
95–100	95–100	80–95	0. 63–2. 0	0. 16–0. 22	5. 1–6. 0	Moderate		Moderate.
100	100	85–95	0. 06–0. 20	0. 12–0. 16	5. 5–6. 5	Moderate to high	High	Moderate.
95–100	85–95	70–85	0. 06–0. 20	0. 06–0. 10	(1)	Moderate	High	Low.
100	100	90–100	0. 2–2. 0	0. 15–0. 22	6. 1–7. 3	Moderate		Low.
100	100	90–100	0. 2–0. 63	0. 14–0. 17	6. 6–7. 3	High	High	Low.
85–100	80–100	45–85	0. 2–0. 63	0. 14–0. 17	7. 4–7. 0	High	High	Low.
90–100	90–100	75–90	0. 63–2. 0	0. 17–0. 22	5. 1–5. 5	Moderate		Moderate.
95–100	90–100	80–90	0. 2–0. 63	0. 10–0. 17	4. 5–6. 5	Moderate	High	High to moderate.
90–100	85–95	70–85	0. 2–0. 63	0. 06–0. 10	[2] 7. 4–7. 0	Moderate to low	High	Low.
90–100	80–95	55–75	0. 63–2. 0	0. 12–0. 18	6. 6–7. 3	Moderate		Low.
90–100	70–80	60–75	2. 0 –6. 3	0. 10–0. 14	6. 1–7. 3	Moderate to low	Moderate	Low.
60–90	20–60	12–35	6. 3–12. 0+	0. 04–0. 10	(1)	Low	Low	Low.
75–90	55–80	40–60	0. 2 –6. 3	0. 17–0. 22	5. 1–5. 5	Low		Moderate.
50–80	30–55	15–40	0. 63–2. 0	0. 08–0. 12	4. 5–5. 5	Moderate	Low	High.
100	100	85–95	0. 63–2. 0	0. 16–0. 22	5. 1–6. 0	Moderate		Moderate.
100	100	85–95	< 0. 2	0. 10–0. 15	4. 5–6. 0	High	High	Moderate.
90–100	85–95	75–85	0. 2–0. 63	0. 10–0. 14	[2] 7. 4–7. 0	Low	Moderate	Low.
85–100	80–100	70–90	0. 63–2. 0	0. 17–0. 22	6. 6–7. 3	Moderate		Low.
85–100	80–100	65–90	0. 63–2. 0	0. 15–0. 20	6. 6–7. 3	Moderate	Moderate	Low.
85–100	80–90	40–80	2. 0–6. 3	0. 12–0. 17	6. 6–7. 8	Moderate	Moderate	Low.
85–100	85–100	65–80	0. 63–2. 0	0. 16–0. 22	6. 6–7. 3	Low		Low.
85–95	70–90	55–75	0. 63–2. 0	0. 10–0. 17	6. 1–7. 3	Moderate	Moderate	Low.
25–60	20–35	0–15	6. 3–12. 0	0. 01–0. 05	(1)	Low	Very low	Low.
100	90–100	80–95	0. 63–2. 0	0. 17–0. 26	6. 6–7. 3	Low to moderate		Low.
90–100	80–100	80–90	0. 63–2. 0	0. 16–0. 24	6. 6–7. 3	Moderate	Moderate	Low.
90–100	80–90	40–75	2. 0–6. 3	0. 10–0. 15	6. 6–7. 3	Low to moderate	Low	Low.
95–100	90–100	75–95	0. 2–2. 0	0. 17–0. 26	6. 6–7. 3	Low to moderate		Low.
85–100	80–100	70–95	0. 63–2. 0	0. 13–0. 24	6. 6–7. 3	Moderate	Low	Low.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Loudonville (LoB, LoC2)	>3	1½–3½	0–13	Silt loam	ML	A–4
			13–32	Silty clay loam or clay loam	CL	A–6
			32–48	Sandstone bedrock.		
Loudonville (shallow variant) (LsF)	>3	1–2	0–4	Silt loam	ML	A–4
			4–13	Silty clay loam or clay loam	CL	A–6
			13–36	Sandstone bedrock.		
McGary (MgA)	<1.5	>5	0–8	Silt loam	ML, CL	A–4, A–6
			8–55	Silty clay or silty clay loam	CH, CL	A–6, A–7
			55–70	Silty clay loam to sandy loam	CL, SC, GC	A–4, A–6
Millsdale (Mn)	<1	1⅔–3⅓	0–9	Silty clay loam	CL	A–6, A–7
			9–30	Silty clay loam to silty clay	CH, MH	A–7
			30–50	Limestone.		
Milton (MoA, MoB, MoB2, MoC2, MoD2).	>3	1⅔–3⅓	0–7	Silt loam	ML	A–4
			7–26	Silty clay loam to silty clay	CL, CH	A–7
			26–48	Limestone.		
Morley (MrB, MrB2, MrC, MrC2, MrD, MrD2, MrE2, MsC3, MsD3).	1.5	>5	0–7	Silt loam	ML, ML–CL	A–4
			7–34	Silty clay or silty clay loam	CH, CL	A–7, A–6
			34–60	Clay loam	CL	A–6
Ockley (OcA, OcB, OcB2, OcC, OcC2, OcD2).	>3	>5	0–8	Silt loam	ML, ML–CL	A–4
			8–19	Silt loam and silty clay loam	CL, ML–CL	A–6
			19–51	Gravelly clay loam	CL, SC	A–6
			51–60	Sand and gravel	GW, GM, SW, SM	A–1, A–2
Ockley (till substratum) (OsB)	>3	>5	40–60	Glacial till	CL, ML–CL	A–6
Pewamo (Pw)	0–1	>5	0–13	Silty clay loam	MH, CH, ML, CL	A–7, A–6
			13–40	Silty clay or silty clay loam	CH, CL, ML–CL	A–7, A–6
			40–74	Silty clay loam	CL	A–6
Randolph (RaA)	<1.5	1½–3½	0–7	Silt loam	ML	A–4
			7–32	Clay loam or silty clay	CL, CH	A–6, A–7
			32–50	Limestone.		
Rarden (RdB2, RdC2, RdE, RdF)	>3	1½–3½	0–5	Silt loam	ML	A–4
			5–28	Clay	CH	A–7
			28–40	Fragmented shale to hard shale.		
Ritchey (RhB, RhC2, RhE2)	>3	<2	0–8	Silt loam	ML	A–4
			8–19	Silty clay loam or silty clay	CH	A–7
			19–24	Limestone.		
Rock land (Rk)	>3	0–2	0–8	Silt loam	ML	A–4
			8–36	Limestone.		
Ross (Rn)	>3	>5	0–43	Silt loam	ML	A–4
			43–60	Silty clay loam	CL, ML	A–6
Shoals (Sh)	0–1.5	>5	0–13	Silt loam	ML, ML–CL	A–4, A–6
			13–30	Silt loam or loam	ML, CL	A–4, A–6
			30–50	Gravelly loam	ML, CL or SM	A–4, A–6
Sleeth (SlA, SlB)	0–1.5	>5	0–9	Silt loam	ML	A–4
			9–31	Clay loam	CL	A–6
			31–56	Gravelly clay loam	CL, SC	A–6
			56–60	Gravelly sand	GP, GW, GM, SP, SW, SM	A–1, A–2

properties of soils—Continued

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					Steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
85–100	85–90	70–80	0.63–2.0	0.17–0.22	5.1–5.5	Moderate		Moderate.
85–95	75–90	65–85	0.63–2.0	0.10–0.17	4.6–5.5	Moderate	Moderate	High to moderate.
85–100	85–90	70–80	0.63–2.0	0.17–0.22	6.1–6.5	Moderate		Low.
85–95	75–90	65–85	0.63–2.0	0.10–0.17	5.1–5.5	Moderate	Moderate	Moderate.
100	90–100	85–95	0.2–2.0	0.17–0.22	6.1–6.6	Moderate		Low.
100	90–100	85–95	<0.2	0.10–0.17	5.6–7.3	High	High	Moderate.
85–100	80–95	40–80	<0.2	0.03–0.17	7.3–8.0	Moderate	High	Low.
100	100	85–95	0.63–2.0	0.14–0.18	6.1–6.5	Moderate		Low.
100	100	85–100	0.2–0.63	0.12–0.16	6.1–7.3	High	High	Low.
100	100	80–90	0.63–2.0	0.17–0.22	6.1–6.5	Moderate		Low.
90–100	80–95	70–90	0.2–0.63	0.14–0.18	5.6–7.3	High	Moderate	Low.
90–100	90–100	75–85	0.63–2.0	0.17–0.22	6.6–7.3	Moderate		Low.
95–100	95–100	80–90	0.2–0.63	0.12–0.16	5.6–7.3	High	Moderate to high	Moderate.
85–100	80–100	75–85	0.2–0.63	0.06–0.10	(1)	Moderate	High	Low.
90–100	90–100	75–90	0.63–2.0	0.17–0.22	6.6–7.3	Low		Low.
80–100	80–100	80–95	0.2–2.0	0.12–0.17	6.1–6.5	Moderate	Low	Low.
85–100	60–80	45–65	0.2–2.0	0.12–0.16	6.1–7.3	Moderate	Low	Low.
25–60	20–30	0–15	>6.3	0.03–0.08	(1)	Low	Low	Low.
90–100	80–95	65–85	0.2–0.63	0.06–0.10	(1)	Moderate	Low	Low.
100	95–100	85–100	0.2–2.0	0.15–0.22	5.6–6.0	Moderate		Moderate.
100	95–100	80–95	0.2–0.63	0.12–0.16	5.6–7.3	High	Moderate to high	Moderate to low.
95–100	85–95	70–85	0.2–0.63	0.08–0.12	(1)	Moderate	Moderate	Low.
90–100	90–100	80–95	0.63–2.0	0.16–0.22	5.6–6.0	Moderate		Moderate.
85–100	80–95	75–85	0.2–0.63	0.14–0.18	[2] 5.5–7.0	High	High	Moderate to low.
100	90–100	90–100	0.2–2.0	0.17–0.22	5.1–5.5	Moderate		Moderate.
95–100	90–100	85–95	<0.2	0.10–0.15	4.5–5.0	High	High	High.
90–100	90–100	80–95	0.63–2.0	0.10–0.18	6.6–7.3	Moderate		Low.
85–95	80–90	80–90	0.2–0.63	0.10–0.14	6.6–7.8	High	High	Low.
85–100	75–95	70–95	0.3–2.5	0.15–0.22	6.0–7.5	Moderate		Low.
90–100	85–95	75–90	0.63–2.0	0.17–0.26	6.6–7.3	Low		Low.
95–100	90–95	80–90	0.63–2.0	0.15–0.20	6.6–7.3	Moderate	Low	Low.
100	95–100	80–90	0.63–2.0	0.17–0.22	6.6–7.3	Moderate		Low.
85–95	80–90	60–85	0.2–0.63	0.15–0.20	6.6–7.3	Moderate	High	Low.
80–90	55–75	40–60	0.63–2.0	0.09–0.12	6.6–7.3	Low	High	Low.
100	95–100	70–80	0.63–2.0	0.17–0.22	6.1–6.5	Moderate		Low.
100	85–100	70–85	0.2–0.63	0.12–0.17	5.6–6.5	Moderate	High	Moderate to low.
75–85	55–75	40–70	0.2–0.63	0.10–0.14	[2] 6.6–7.0	Moderate	High	Low.
40–60	25–40	4–15	6.3–12.0	0.01–0.04	(1)	Low	High	Low.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth to bedrock	Depth from surface	Classification: USDA texture	Unified	AASHO
	Feet	*Feet*	*Inches*			
Sloan (So)	0-1	>5	0-13	Silty clay loam	CL	A-6
			13-49	Silty clay loam or clay loam	CL, CH	A-6, A-7
			49-61	Clay loam to silty clay loam	CL	A-6
Thackery (ThA, ThB)	1.5-3	>5	0-14	Silt loam	ML	A-4
			14-45	Gravelly clay loam or sandy clay loam.	CL, SC	A-6
			45-60	Sand and gravel	SP, GP, SM, GM	A-1, A-2
Westland (Wu)	0-1	>5	0-12	Silty clay loam	CL, ML-CL	A-6
			12-42	Gravelly clay loam or clay loam.	CL	A-6, A-7
			42-54	Sand and gravel	SM, SP, SW, GM, GW, GP	A-1, A-2
Willette (Wv)	0-1	>4	0-24	Muck	Pt	----------
			24-42	Silty clay loam or clay	CH	A-7

[1] Calcareous.
[2] Calcareous in some places.

TABLE 6.—*Engineering*

[Borrow pit (Bp), Gravel pit (Gp), Made land (Ma), Quarry (Qu), and Rock

Soil series and map symbols	Suitability for winter grading	Suscepti-bility to frost action	Suitability as source of—: Topsoil	Sand and gravel	Road fill: Solum	Road fill: Substratum	Soil features affecting—: Highway location
Alexandria (AdC, AdC2, AdD, AdD2, AdE, AdE2, AeC3, AeE3, AmF2). (For interpretations of Morley soils in mapping unit AmF2, refer to the Morley series.)	Poor	Moderate	Fair	Not suitable	Fair	Fair	Slope
Algiers (As)	Poor	High	Good	Not suitable	Poor [2]	Poor [2]	High water table; subject to flooding; moderately slow permeability; soft when wet.
Bennington (BeA, BeB, BeB2).	Poor	High	Fair	Not suitable	Poor	Fair	Seasonal high water table; clayey subsoil; slow perme-ability.
Bennington (shale substratum) (BgA, BgB).	Poor	High	Fair	Not suitable	Poor	Poor; shale substratum.	Seasonal high water table; clayey subsoil; slow permea-ability; shale at depth of 3½ to 5 feet.

properties of soils—Continued

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Shrink-swell potential	Corrosion potential	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					Steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
100	95–100	75–80	0.63–2.0	0.15–0.22	5.5–7.3	Moderate		Moderate to low.
100	95–100	65–85	0.2–2.0	0.15–0.20	6.6–7.3	Moderate	High	Low.
75–95	60–95	50–80	<0.2–2.0	0.10–0.17	7.3–7.8	Moderate	High	Low.
100	95–100	75–95	0.63–2.0	0.17–0.22	5.6–7.3	Moderate		Moderate to low.
95–100	60–85	45–65	0.63–2.0	0.12–0.18	6.1–7.3	Moderate	High	Low.
40–90	20–50	5–35	6.3–12.0	0.04–0.10	(1)	Low	Moderate to low	Low.
100	100	75–95	0.63–2.0	0.15–0.22	6.6–7.3	Moderate		Low.
95–100	75–95	65–85	0.2–0.63	0.14–0.17	6.6–7.8	Moderate	High	Low.
35–90	20–50	5–25	>6.3	0.04–0.10	(1)	Low	High	Low.
			2.0–6.3	0.24–0.28	6.6–7.3			Low.
100	95–100	80–90	0.2–0.63	0.08–0.15	(1)	High	High	Low.

interpretations of the soils

land (Rk) are so variable that interpretations for them were not made]

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment [1]				
Slow seepage	Fair stability; slow permeability; fair compaction.	Not needed	Moderate water-holding capacity; moderately slow permeability.	Gentle to strong slopes; moderate erodibility.	Susceptibility to erosion.
Subject to flooding; slow seepage; some thin sand lenses.	Fair stability; slow permeability; good compaction; wet borrow material.	High water table; moderately slow permeability; subject to flooding.	High water table; moderately slow permeability; subject to flooding.	Not needed	Subject to flooding.
Slow seepage	Fair stability; slow permeability; fair compaction.	Slow permeability; seasonal high water table.	Moderately slow infiltration; slow permeability; seasonal high water table.	Nearly level to gentle slopes; moderate erodibility.	Seasonal high water table.
Shale at depth of 3½ to 5 feet.	Fair stability; slow permeability; fair compaction.	Slow permeability; seasonal high water table.	Moderately slow infiltration; slow permeability; seasonal high water table.	Nearly level to gentle slopes; moderate erodibility.	Seasonal high water table.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of— Topsoil	Sand and gravel	Road fill: Solum	Road fill: Substratum	Soil features affecting— Highway location
Blount (BlA, BlB)	Poor	High	Fair	Not suitable	Poor	Fair	Seasonal high water table; clayey subsoil; moderately slow permeability.
Bonpas (Bo)	Poor	High	Good	Not suitable	Poor [2]	Poor [2]	Seasonal high water table; moderately slow to slow permeability; soil material soft when wet.
Cardington (CaB, CaB2, CaC, CaC2).	Poor	High	Fair	Not suitable	Fair	Fair	Moderately slow permeability; seasonal high water table.
Casco (CfE2) (For interpretations of the Fox soil in this mapping unit, refer to the Fox series.)	Good	Low	Fair	Good. Well graded.	Fair	Good	Steep slopes
Colyer (ClF)	Good to fair	Low	Poor	Not suitable	Poor	Unsuitable; shale; limited amount of soil material.	Shale at depth of 1 or 1½ feet; steep slopes.
Condit (CnA)	Poor	High	Poor	Not suitable	Poor	Fair	Seasonal high water table; clayey subsoil; slow permeability.
Eel (Ee)	Poor	Moderate	Good	Not suitable	Fair	Fair	Subject to flooding; seasonal high water table.
Fox (FlA, FlB, FnA, FnB, FnB2, FnC, FnC2, FnD2).	Fair to depth of 24 to 40 inches and good below.	Low	Fair	Good below a depth of 2 to 3 feet. Well graded and stratified sand and gravel.	Fair	Good	Soil features favorable.
Genesee (Gn)	Fair	Moderate	Good	Not suitable	Fair	Fair	Subject to flooding.
Genesee (shallow variant) (Go).	Fair	Moderate	Good	Not suitable	Fair	Limestone	Subject to flooding; limestone at depth of about 1½ feet.
Loudonville (LoB, LoC2)	Fair	Moderate	Fair	Not suitable	Fair	Sandstone and shale.	Sandstone and shale at depth of 1½ to 4 feet.
Loudonville (shallow variant) (LsF).	Fair	Moderate	Poor	Not suitable	Poor	Sandstone and shale.	Sandstone and shale at depth of 1 or 1½ feet.

See footnote at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment [1]				
Slow seepage	Fair stability; slow permeability; fair compaction.	Moderately slow permeability; seasonal high water table.	Moderately slow infiltration and permeability; seasonal high water table.	Nearly level to gentle slopes; moderate erodibility.	Seasonal high water table.
Very slow seepage; some thin sand lenses.	Fair stability; slow permeability; poor compaction; wet borrow material.	Seasonal high water table; moderately slow to slow permeability.	Seasonal high water table; moderately slow to slow permeability.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Slow seepage	Fair stability; moderately slow permeability; good compaction.	Moderately slow permeability; seasonal high water table.	Moderately slow permeability; seasonal high water table.	Moderate erodibility	Susceptible to moderate erosion.
Excessive seepage in substratum.	Adequate strength and stability; rapid to very rapid permeability.	Not needed	Rapid infiltration if runoff is controlled on steep slopes; low water-holding capacity.	Steep slopes; erodibility.	Steep slopes; erodibility.
Pervious shale at depth of 1 to 1½ feet.	Limited amount of soil material available; fair to poor compaction.	Not needed	Very steep slopes; normally not irrigated.	Very steep slopes	Very steep slopes; erodibility; droughty.
Slow seepage	Fair stability; seasonal high water table.	Slow permeability; seasonal high water table.	Moderately slow infiltration; slow permeability; seasonal high water table.	Nearly level; seasonal high water table.	Seasonal high water table.
Subject to flooding; permeable substratum.	Fair stability; slow permeability; fair to good compaction.	Moderate permeability.	Moderate infiltration and permeability; high water-holding capacity; subject to flooding.	Nearly level; subject to flooding.	Nearly level; subject to flooding.
Excessive seepage in clean sand and gravel.	Adequate strength and stability; moderate permeability.	Not needed	Moderate infiltration; medium water-holding capacity.	Nearly level to moderately steep slopes; moderate permeability.	Nearly level to moderately steep slopes; moderate permeability; erodible on moderately steep slopes.
Subject to flooding; permeable substratum.	Fair stability; slow permeability.	Not needed	Moderate infiltration and permeability; high water-holding capacity; subject to flooding.	Nearly level; subject to flooding.	Nearly level; subject to flooding.
Limestone at depth of about 1½ feet.	Fair stability; slow permeability.	Not needed	Moderate infiltration and permeability; medium to high water-holding capacity; subject to flooding.	Nearly level; subject to flooding.	Nearly level; subject to flooding.
Pervious sandstone and shale at depth of 1½ to 4 feet.	Fair stability; slow permeability; fair compaction.	Not needed	Moderate infiltration and permeability; medium to low water-holding capacity.	Sandstone and shale at depth of 1½ to 4 feet; gentle to moderately steep slopes; droughty.	Sandstone and shale at depth of 1½ to 4 feet; erodibility; droughty.
Pervious sandstone and shale at depth of 1 or 1½ feet.	Sandstone and shale at depth of 1 or 1½ feet.	Not needed	Steep slopes	Steep slopes	Steep slopes; erodibility.

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	Road fill		Highway location
					Solum	Substratum	
Marsh (Mc)	Poor	High	Poor	Not suitable	Poor [2]	Poor [2]	High water table; subject to flooding; wet and soft soil material.
McGary (MgA)	Poor	High	Fair	Not suitable	Poor [2]	Poor [2]	Seasonal high water table; slow permeability; soil material soft when wet.
Millsdale (Mn)	Poor	High	Good	Not suitable	Poor [2]	Limestone	Limestone at depth of 1⅔ to 3⅓ feet; seasonal high water table.
Milton (MoA, MoB, MoB2, MoC2, MoD2).	Poor	Moderate	Fair	Not suitable for sand and gravel; good for limestone.	Poor	Limestone	Limestone at depth of 1⅔ to 3⅓ feet.
Morley (MrB, MrB2, MrC, MrC2, MrD, MrD2, MrE2, MsC3, MsD3).	Poor	High	Fair	Not suitable	Fair	Fair	Moderately slow permeability; seasonal high water table.
Ockley (OcA, OcB, OcB2, OcC, OcC2, OcD2).	Fair to depth of about 50 inches and good below.	Moderate	Good	Good for sand, and below a depth of 50 inches, good for gravel; well graded and stratified.	Fair	Good	Soil features favorable.
Ockley (till substratum) (OsB).	Fair	Moderate	Good	Not suitable	Fair	Fair	Soil features favorable.
Pewamo (Pw)	Poor	High	Good	Not suitable	Poor [2]	Poor [2]	High water table; clayey subsoil; moderately slow permeability.
Randolph (RaA)	Poor	High	Fair	Not suitable	Poor	Limestone	Seasonal high water table; limestone at depth of 1½ to 3½ feet.
Rarden (RdB2, RdC2, RdE, RdF).	Poor	High	Poor	Not suitable	Poor	Shale	Clayey subsoil; shale at depth of 1½ to 3½ feet
Ritchey (RhB, RhC2, RhE2).	Poor	High	Poor	Not suitable for sand and gravel; good for limestone.	Poor	Limestone; limited amount of soil material.	Limestone at depth of 1 or 1½ feet.
Ross (Rn)	Fair	Moderate	Good	Not suitable	Fair	Fair to good	Subject to flooding.
Shoals (Sh)	Poor	High	Good	Not suitable	Poor [2]	Poor [2]	High water table; subject to flooding; moderately slow to slow permeability.

interpretations of the soils—Continued

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment [1]				
Subject to flooding	Poor stability; poor compaction.	Subject to flooding	Not needed	Not needed	Not needed.
Very slow seepage	Poor stability; slow permeability; poor compaction.	Seasonal high water table; slow permeability.	Slow infiltration and permeability; seasonal high water table.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Limestone at depth of 1⅔ to 3⅓ feet.	Limited amount of material; poor stability and compaction.	Seasonal high water table; moderately slow permeability.	Moderate infiltration and moderately slow permeability; seasonal high water table.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Limestone at depth of 1⅔ to 3⅓ feet.	Limestone at depth of 1⅔ to 3⅓ feet; slow permeability; fair compaction.	Not needed	Moderately slow permeability; medium water-holding capacity.	Nearly level to moderately steep slopes; limestone at depth of 1⅔ to 3⅓ feet.	Erodibility; limestone at depth of 1⅔ to 3⅓ feet.
Slow seepage	Fair stability; moderately slow permeability; fair compaction.	Moderately slow permeability; seasonal high water table.	Moderately slow permeability; seasonal high water table.	Gentle to steep slopes; erodibility.	Gentle to steep slopes; erodibility.
Excessive seepage in substratum.	Good stability; slow permeability; good compaction.	Not needed	Moderate permeability; high water-holding capacity.	Nearly level to moderately steep slopes; erodibility.	Nearly level to moderately steep slopes; erodibility.
Slow seepage	Good stability; slow permeability; good compaction.	Not needed	Moderately permeable; high water-holding capacity.	Soil features favorable.	Erodibility.
Very slow seepage	Fair stability; slow permeability; fair to poor compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; nearly level.	Seasonal high water table; nearly level.
Limestone at depth of 1½ to 3½ feet.	Fair stability; slow permeability; fair compaction.	Seasonal high water table; moderately slow permeability; limestone at depth of 1½ to 3½ feet.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; limestone at depth of 1½ to 3½ feet.	Seasonal high water table; limestone at depth of 1½ to 3½ feet; erodibility.
Shale at depth of 1½ to 3½ feet; very slow seepage.	Poor stability; very slow permeability; poor compaction.	Not needed	Slow infiltration; moderately slow permeability; low productivity.	Nearly level to very steep slopes; erodibility.	Nearly level to very steep slopes; erodibility.
Limestone at depth of 1 or 1½ feet.	Limited amount of soil material; fair stability; slow permeability.	Not needed	Moderately slow permeability; low water-holding capacity; limestone at depth of 1 or 1½ feet.	Limestone at depth of 1 or 1½ feet; gentle to steep slopes.	Limestone at depth of 1 or 1½ feet; erodibility.
Permeable substratum; subject to flooding.	Fair stability; slow permeability; fair to good compaction.	Not needed	Moderately permeable; high water-holding capacity; subject to flooding.	Nearly level; subject to flooding.	Subject to flooding.
Subject to flooding; permeable in substratum.	Fair stability; slow permeability; good compaction.	Subject to flooding; moderately slow to slow permeability; high water table.	High water table; subject to flooding; moderately slow to slow permeability.	High water table; subject to flooding.	High water table; 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	Road fill		Highway location
					Solum	Substratum	
Sleeth (SlA, SlB)	Poor	High	Good	Good for gravel below a depth of 4 or 5 feet; good for sand; poorly graded and stratified; calcareous.	Fair	Good	Seasonal high water table; moderately slow permeability.
Sloan (So)	Poor	High	Good	Not suitable	Poor [2]	Poor [2]	High water table; subject to flooding; moderately slow to slow permeability; soil material soft when wet.
Thackery (ThA, ThB)	Poor	High	Good	Good for gravel below a depth of 4 feet; good for sand; poorly graded and stratified.	Fair	Good	Moderate permeability.
Westland (Wu)	Poor	High	Good	Good for gravel below a depth of 3 to 5 feet; good for sand; poorly graded and stratified.	Fair	Good	Seasonal high water table; moderately slow permeability.
Willette (Wv)	Poor	High	Poor	Not suitable	Not suitable (muck).	Poor [2]	High water table; saturated muck over clayey material; soil materiel soft when wet.

[1] Features listed also apply to dikes and levees. Permeability is rated for soil material compacted in an embankment.

The tests for liquid limit and plastic limit 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 the 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.

Table 4 also gives moisture-density data for the tested soils. If a soil material is compacted at successively high moisture content, assuming that the compactive effort remains constant, the density of a compacted material increases until the optimum moisture content is reached. After that, the density decreases with 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, soil material is most stable if it is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Engineering properties of soils

Table 5 shows some estimated soil properties that are important in engineering, and it gives estimated AASHO and Unified classifications for the soils. The textural terms used to describe the soil material in the main horizons are those used by the U.S. Department of Agriculture. The data in table 5 are based on the results of soil tests shown in table 4, on information in other parts of this survey, and on experience with the same kinds of soil in other counties.

In table 5, depth to a seasonal high water table refers to the shallowest depth to which the water table rises in winter and early in spring. This water table may be a perched one or an ordinary ground-water table. If precipitation is less than normal during the wet season, the water table and the saturated soil are farther from the surface. Soil conditions immediately after heavy precipitation are not considered. In all soils, particularly those on slopes and on uplands, the depth to the water table is generally

interpretations of the soils—Continued

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment [1]				
Excessive seepage in substratum; seasonal high water table.	Good stability; permeable; good compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Subject to flooding; slow seepage; pervious layers of sand in some places.	Fair stability; permeable; good compaction; wet borrow material.	High water table; moderately slow to slow permeability; subject to flooding.	High water table; moderately slow to slow permeability; subject flooding.	Nearly level; high water table; subject to flooding.	High water table; subject to flooding.
Excessive seepage in substratum.	Good stability; permeable; good compaction.	Seasonal high water table.	Seasonal high water table; high water-holding capacity.	Soil features favorable.	Soil features favorable.
Excessive seepage in substratum; seasonal high water table.	Good stability; permeable; fair compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Seasonal high water table.	Seasonal high water table.
Subject to flooding; very slow seepage in substratum; high water table.	Not suitable (muck); poor stability and compaction in substratum.	High water table.	High water table.	High water table.	High water table.

[2] Fair when soil material is removed and dried to optimum moisture content.

greater late in spring, in summer, and in fall than the depth shown in table 5.

Most of the soils in the county are deeper than 5 feet to bedrock, but the Colyer, Loudonville, and other soils are less than 5 feet to bedrock.

Permeability reflects the ability of the soil to transmit water and air. In table 5, permeability, estimated in inches of water percolation per hour, is based on the texture, structure, and porosity of the soil and on selected permeability tests. These tests assume that the soil is saturated but that there is no hindrance to free drainage.

The available moisture capacity, estimated in inches per inch of soil depth, is the approximate amount of capillary water in a soil that is wet to field capacity. When the soil is air dry, this amount of water wets the soil material to a depth of 1 inch without deeper percolation. For medium-textured and fine-textured soils, the estimated values listed are based on the difference in percentage of moisture retained at 1/3 and 15 atmospheres of tension. For sandy soils, the estimated values are based on the difference between 1/10 and 15 atmospheres of tension. For compact glacial till, the estimated values listed in table 5 are lower than normal for a given texture; the increased bulk density reduces the penetration of roots and, therefore, not all of the stored moisture is available to plants.

In table 5, reaction is given in pH values, which indicate the degree of acidity or alkalinity of the soil material. Higher values indicate alkaline material and lower values acid material, as shown in the Glossary.

Shrink-swell potential is an indication of the change in volume of the soil material expected when its moisture content changes. Soils that have a high shrink-swell potential are normally undesirable for some engineering uses because their bearing capacity is generally lessened when their volume is increased by swelling when wet. Shrink-swell potential is estimated primarily on the basis of the amount and kind of clay the soil contains.

Corrosion potential is important because it indicates the effect that solvents in a soil have on the corrosion of utility pipelines. In table 5 estimates are for steel and concrete pipes.

Engineering interpretations of soils

In table 6, the soils of the county are rated according to their suitability for winter grading, susceptibility to frost action, and suitability as a source of topsoil, sand and gravel, and road fill. In addition, table 6 lists soil features that affect suitability of the soils for highway location and for engineering structures and practices. Following are explanations of the data in the columns of table 6.

Suitability for winter grading.—Because of wetness, plasticity, and susceptibility to frost action, most of the soils in the county are poorly suited to winter grading.

Susceptibility to frost action.—Silty and clayey soils that are wet most of the winter are the most susceptible to damaging frost action.

Suitability as a source of topsoil, sand and gravel, and road fill.—The thickness, texture, and natural fertility of the surface layer determine suitability of a soil for use as a topdressing. The amount, quality, and accessibility of granular (coarse-grained) materials are the most important features that affect suitability of a soil for use of sand and gravel as construction material. Well-graded coarse materials or a mixture of clay and coarse-grained materials is suitable as a source of road fill. Highly plastic clayey soils, poorly graded silty soils, and organic soils are difficult to compact and are unsuitable for road fill or are poorly suited.

In the columns under the heading "Soil features affecting—," are listed properties of soils that affect the location of highways, construction and maintenance of farm ponds, and other engineering work.

Highway location.—Soil features that affect the location of highways include depth to rock, a high water table, steep slopes, slippage of soil material, and susceptibility to flooding.

Farm ponds.—The sealing potential of the soil material is the main factor affecting the reservoir area of farm ponds, though depth to bedrock and susceptibility to flooding are also important. Stability, ease or difficulty of compaction, and permeability of soil material affect construction and maintenance of the embankments of farm ponds.

Agricultural drainage.—The soils are described relative to their natural drainage, their in-place permeability, and the presence of a high water table.

Irrigation.—The rate of water intake, permeability, natural drainage, and available water capacity are properties of soils that affect irrigation. Slopes and susceptibility to flooding are also important.

Terraces and diversions.—Slope and susceptibility to erosion are the main features that affect terraces and diversions, though depth to bedrock and height of the water table are also important.

Waterways.—Soil features that affect waterways are about the same as those affecting terraces and diversions, though the degree of the effect may differ.

Soils and Land Use Planning

Delaware County is only a few miles north of the expanding metropolitan area of Columbus, Ohio, and expansion has already affected land use in the southern part. Competition for land is increasing. Most of the county is still used as cropland, but there is a mixing of farm and nonfarm uses. The farming areas are being reduced as residential, industrial, transportation, and recreational facilities are developed.

The expansion of nonfarm uses of land can remove many acres from farm use in a short period. Freeways and superhighways can displace as much as 50 acres per mile. Shopping centers may be large enough to displace 50 to 100 acres. These uses permanently remove land from agricultural use.

This section of the soil survey provides information on the properties of the soils and their effect on selected nonfarm use of land. It will help community planners and industrial users of land, who generally look for areas that are least costly to develop and maintain. Development and maintenance costs are related to soil limitations. These planners will find other useful information on the soil maps and in other parts of this survey. Table 7 gives the estimated degree and kinds of limitation of soils for some selected land uses. By using this information, alternative uses can be developed as a basis for long-range planning and zoning. Because extensive manipulation of the soil alters some of its natural properties, the ratings for some uses will no longer apply to areas that have undergone extensive cutting and filling.

The estimated degree of limitations of the soils for a specified land use are slight, moderate, and severe. A rating of *slight* indicates that the soil has no important limitation to the specified use. *Moderate* shows that the soil has some limitations to the specified use. These limitations need to be recognized, but they can be overcome or corrected. A rating of *severe* indicates that the soil has serious limitations that are difficult to overcome. A severe rating, however, does not mean that the soil cannot be used for the specific use.

Following are explanations of the uses rated in table 7.

Cultivated crops.—The soils have been rated according to their limitations to use for cultivated crops. The degree of limitation is based on the land capability classes, which are explained in the section "Capability Groups of Soils." Erosion, wetness, droughtiness, stoniness, and other hazards to cropping were considered in making these ratings. Cultivated crops are rated in this table to aid planners for land use when they consider whether or not farming is a sound use.

Homesite locations.—In this county the major features that limit the use of soils as homesite locations are depth to bedrock, slope, natural drainage, hazard of flooding, and stoniness or rockiness of the soil surface. Not considered is a method for disposing of sewage. The ratings in table 7 are for houses of three stories or less that have a basement, but the ratings also apply to sites for small industrial, commercial, and institutional buildings.

Flooding is a severe hazard when it occurs. Homes constructed on naturally wet soils probably will have wet basements unless adequate drainage is provided. Some of the wet soils in the county are the Pewamo, Blount, Bennington, and Randolph. In many areas tile drains and open ditches have been installed for agricultural use, but excavations for homes or other structures can disrupt these systems.

The Bonpas and other soils that have a high content of silt are not so suitable for supporting foundations of buildings as are the Fox and other coarser textured soils. Soils that have a high shrink-swell potential are likely to heave and cause foundations to crack. In addition, shrinking and swelling disrupts the alinement of sidewalks, patios, floors, and rock walls. These effects can be lessened by placing layers of sandy or gravelly material below the structure.

Excavating for basements and installing underground utility lines are difficult and expensive on soils that are shallow to bedrock. On slopes of more than 12 percent, erosion is a hazard and excavating and grading are difficult.

Disposal of sewage effluent.—The suitability of soils for disposing effluent from septic tanks depends on permeability, depth to rock, slope, natural drainage, and hazard of flooding. The use of a soil in the disposal of effluent is severely limited by flooding, by very poor drainage, or by moderately slow to very slow permeability. See table 5 for estimates of permeability.

If filter fields for septic tanks are located on slopes of more than 12 percent, erosion and seepage downslope may be a problem, or the soil may be unstable when saturated. A severe limitation is caused by a restrictive layer, such as solid bedrock, a dense, compact layer, or a layer of clay that interferes with adequate filtration and the removal of effluent.

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 the 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 condition of the soil.

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

Lawns, landscaping, and golf fairways.—In most areas developed for homes and golf courses, the natural surface soil, or topsoil, can be used for lawns, flowers, shrubs, and trees and should be saved. It can be removed from the site, stored until construction and grading are completed, and then returned. The natural surface soil from areas graded for streets also can be used for lawns and fairways. 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 ratings in table 7 are for soils used for streets and parking lots in subdivisions where traffic is not heavy. Considered in estimating the ratings were drainage, slope, depth to rock, hazard of flooding, and stoniness or rockiness. For streets and parking lots in subdivisions, limitations are severe on slopes of more than 6 percent. The percentage of slope selected for the sides of cuts and fills depends on erodibility and on the capacity of the soil for supporting close-growing vegetation.

Campsites.—Campsites for tents should be located in areas where the landscape is attractive, the trafficability is good, and the productivity for grasses and trees is medium or high. Soils in which the natural drainage is good or moderately good have less serious limitations than wetter soils. Limitations are moderate on somewhat poorly drained soils and are severe on poorly drained and very poorly drained soils. In addition, limitations are severe on muck soils, on soils along streams where flooding is a hazard, and on soils in basinlike areas that are ponded after a heavy rain. As a rule, slopes of more than 12 percent have severe limitations for use as tent campsites.

Soils that are firm when moist and are nonsticky when wet are desirable. Among the soils most suitable for campsites are those having a surface layer of loam, silt loam, sandy loam, fine sandy loam, or very fine sandy loam. Limitations are moderate or severe on stony or rocky soils and are severe on loose sand and on very gravelly or very channery soils.

Athletic fields and other intensive play areas.—These areas are fairly small tracts used for baseball diamonds, football fields, and tennis, volleyball, and badminton courts. Because the areas must be nearly level, considerable shaping may be needed. For this reason, the limitation is moderate or severe on slopes of more than 2 percent. Also important is the texture of the surface layer. The limitation is slight for soils that have a surface layer of silt loam, fine sandy loam, very fine sandy loam, loam, or sandy loam. It is moderate for clay loams, sandy clay loams, silty clay loams, or loamy sands, and severe for loose sand and for gravelly, very stony, flaggy, or rocky soils. Flood plains can be used as intensive play areas.

Picnic and extensive play areas.—Considered in rating the soils for picnicking, hiking, nature study, and similar uses were 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 controls gullying. Flood plains can be developed and used as extensive play areas.

Cemeteries and sanitary land fills.—For use as cemeteries, soils have slight or moderate limitations if they are deep, are well drained or moderately well drained, and are on slopes of less than 12 percent. Steeper soils have severe limitations, and so do soils that are somewhat poorly drained to very poorly drained and are affected by a seasonal high water table. If the water table is permanently lowered, limitations are only slight or moderate on some soils. The use of soils for cemeteries is severely limited by hard bedrock near the surface, but it is only slightly or moderately restricted if the underlying materials are soft or rippable. At all periods of the year, ease of excavation is most favorable in the sandier soils. Shoring the sides of excavations is necessary if caving is a problem. Preserving the original surface soil is important, and liming and fertilizing are needed for maintaining sod.

In considering the use of soils for sanitary land fills, the depth to underlying rock is especially important. The most favorable soils for the trench type of sanitary land fills are those underlain by unconsolidated material that is friable. Among features that limit use are shallowness to bedrock, wetness, slow permeability, steep slopes, and flooding.

Descriptions of the Soils

This section describes the soil series and mapping units in Delaware County. The approximate acreage and proportionate extent of each mapping unit are given in table 8.

297-845—69——3

TABLE 7.—*Estimated degree and kinds*

[Borrow pit (Bp), Gravel pit (Gp), Made land (Ma), and Quarry (Qu) generally

Soil series and map symbols	Cultivated crops	Homesite locations for homes of 3 stories or less [1]	Disposal of sewage effluent	Sewage lagoons	Lawns, landscaping, and golf fairways
Alexandria:					
AdC, AdC2	Moderate: Slope; erosion hazard.	Moderate: Slope	Severe: Moderately slow permeability.	Severe: Slope	Moderate: Slope
AdD, AdD2	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope; moderately slow permeability.	Severe: Slope	Severe: Slope
AdE, AdE2, AeE3, AmF2.	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
AeC3	Severe: Slope; erosion hazard.	Moderate: Slope	Severe: Moderately slow permeability.	Severe: Slope	Severe: Erosion hazard.
Algiers:					
As	Slight	Severe: Subject to flooding; poorly drained; soft when wet.	Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.
Bennington:					
BeA, BgA	Slight	Moderate: Somewhat poorly drained.	Severe: Slow permeability.	Slight	Moderate: Somewhat poorly drained.
BgB, BeB, BeB2	Slight	Moderate: Somewhat poorly drained.	Severe: Moderately slow permeability.	Moderate: Slope	Moderate: Somewhat poorly drained.
Blount:					
BlA	Slight	Moderate: Somewhat poorly drained.	Severe: Slow permeability.	Slight	Moderate: Somewhat poorly drained.
BlB	Slight	Moderate: Somewhat poorly drained.	Severe: Slow permeability.	Moderate: Slope	Moderate: Somewhat poorly drained.
Bonpas:					
Bo	Slight	Severe: Very poorly drained; soft when wet.	Severe: Moderately slow permeability.	Slight	Severe: Very poorly drained.
Cardington:					
CaB, CaB2	Slight	Slight	Severe: Moderately slow permeability.	Moderate: Slope	Slight
CaC, CaC2	Moderate: Slope; erosion hazard.	Moderate: Slope	Severe: Moderately slow permeability.	Severe: Slope	Moderate: Slope
Casco-Fox:					
CfE2	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
Colyer:					
ClF	Severe: Shallow; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
Condit:					
CnA	Moderate: Poorly drained.	Severe: Poorly drained.	Severe: Slow permeability; poorly drained.	Slight	Severe: Poorly drained.
Eel:					
Ee	Slight	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.

See footnotes at end of table.

of limitations for land use planning

are not suitable for the uses shown in this table and are not rated]

Streets and parking lots	Campsites		Athletic fields and other intensive play areas	Picnic and extensive play areas	Cemeteries and sanitary land fills
	Tents	Trailers			
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Slope; moderately slow permeability.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Slope; moderately slow permeability.
Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.	Severe: Subject to flooding; poorly drained.
Moderate: Somewhat poorly drained.	Moderate: Somewhat poorly drained; slow permeability.	Moderate: Somewhat poorly drained; slow permeability.	Moderate: Somewhat poorly drained.	Severe: Somewhat poorly drained; slow permeability.	Severe: Somewhat poorly drained; slow permeability.
Moderate: Slope; somewhat poorly drained.	Moderate: Somewhat poorly drained.	Moderate: Slope; somewhat poorly drained.	Moderate: Slope; somewhat poorly drained.	Moderate: Somewhat poorly drained.	Severe: Somewhat poorly drained.
Moderate: Somewhat poorly drained.	Severe: Slow permeability.	Severe: Slow permeability.	Severe: Slow permeability.	Moderate: Somewhat poorly drained.	Severe: Somewhat poorly drained; slow permeability.
Moderate: Slope; somewhat poorly drained.	Severe: Slow permeability.	Severe: Slow permeability.	Severe: Slow permeability.	Moderate: Somewhat poorly drained.	Severe: Somewhat poorly drained; slow permeability.
Severe: Very poorly drained; soft when wet.	Severe: Very poorly drained; subject to ponding.	Severe: Very poorly drained; subject to ponding.	Severe: Very poorly drained; moderately slow permeability.	Severe: Very poorly drained; subject to ponding.	Severe: Very poorly drained.
Moderate: Slope	Moderate: Moderately slow permeability.	Moderate: Slope; moderately slow permeability.	Moderate: Slope; moderately slow permeability.	Slight	Moderate: Moderately slow permeability.
Severe: Slope	Moderate: Slope; moderately slow permeability.	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Slope; moderately slow permeability.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Poorly drained.	Severe: Slow permeability; poorly drained.	Severe: Slow permeability; poorly drained.	Severe: Slow permeability; poorly drained.	Severe: Slow permeability; poorly drained.	Severe: Slow permeability; poorly drained.
Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Slight	Slight	Severe: Subject to flooding.

TABLE 7.—*Estimated degree and kinds of limi-*

Soil series and map symbols	Cultivated crops	Homesite locations for homes of 3 stories or less [1]	Disposal of sewage effluent	Sewage lagoons	Lawns, landscaping, and golf fairways
Fox:					
FlA, FnA	Slight	Slight	Slight [2]	Severe: Permeable material.	Slight: Droughty
FlB, FnB, FnB2	Slight	Slight	Slight [2]	Severe: Permeable material.	Slight: Droughty
FnC, FnC2	Moderate: Slope; erosion hazard.	Moderate: Slope	Moderate: Slope [2]	Severe: Slope; permeable material.	Moderate: Slope
FnD2	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
Genesee:					
Gn	Slight	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.
Go	Slight	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.
Loudonville:					
LoB	Slight	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Moderate: Limited depth to rock.
LoC2	Moderate: Slope; erosion hazard.	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Severe: Slope; limited depth to rock.	Moderate: Slope; limited depth to rock.
LsF	Severe: Slope; erosion hazard.	Severe: Slope; limited depth to rock.	Severe: Slope; limited depth to rock.	Severe: Slope; limited depth to rock.	Severe: Slope; limited depth to rock.
Marsh:					
Mc		Severe: Very poorly drained; soft when wet.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.
McGary:					
MgA	Slight	Moderate: Somewhat poorly drained; soft when wet.	Severe: Slow permeability.	Slight	Moderate: Somewhat poorly drained.
Millsdale:					
Mn	Moderate: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained; limited depth to rock; moderately slow permeability.	Severe: Limited depth to rock.	Severe: Very poorly drained.
Milton:					
MoA	Slight	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Moderate: Limited depth to rock.
MoB, MoB2	Slight	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Moderate: Limited depth to rock.
MoC2	Moderate: Slope; erosion hazard.	Severe: Limited depth to rock.	Severe: Limited depth to rock.	Severe: Slope; limited depth to rock.	Moderate: Slope; limited depth to rock.
MoD2	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope; limited depth to rock.	Severe: Slope	Severe: Slope
Morley:					
MrB	Slight	Slight	Severe: Moderately slow permeability.	Moderate: Slope	Slight
MrB2	Moderate: Slope; erosion hazard.	Slight	Severe: Moderately slow permeability.	Moderate: Slope	Slight
MrC, MrC2	Moderate: Slope; erosion hazard.	Moderate: Slope	Severe: Moderately slow permeability.	Severe: Slope	Moderate: Slope
MsC3	Severe: Past erosion.	Moderate: Slope	Severe: Moderately slow permeability.	Severe: Slope	Severe: Erosion hazard.

See footnotes at end of table.

tations for land use planning—Continued

Streets and parking lots	Campsites		Athletic fields and other intensive play areas	Picnic and extensive play areas	Cemeteries and sanitary land fills
	Tents	Trailers			
Slight	Slight	Slight	Slight	Slight	Slight.[2]
Moderate: Slope	Slight	Moderate: Slope	Moderate: Slope	Slight	Slight.[2]
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Slope.[2]
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Slight	Slight	Severe: Subject to flooding.
Severe: Subject to flooding.	Severe: Shallow to bedrock; subject to flooding.	Severe: Shallow to bedrock; subject to flooding.	Severe: Shallow to bedrock.	Severe: Shallow to bedrock.	Severe: Subject to flooding.
Severe: Limited depth to rock.	Slight	Moderate: Slope	Severe: Limited depth to rock.	Moderate: Limited depth to rock.	Severe: Limited depth to rock.
Severe: Slope; limited depth to rock.	Moderate: Slope	Severe: Slope	Severe: Slope; limited depth to rock.	Moderate: Limited depth to rock.	Severe: Limited depth to rock.
Severe: Slope; limited depth to rock.	Severe: Slope; limited depth to rock.	Severe: Limited depth to rock.	Severe: Slope; limited depth to rock.	Severe: Slope; limited depth to rock.	Severe: Slope; limited depth to rock.
Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.
Moderate: Somewhat poorly drained.	Severe: Somewhat poorly drained; slow permeability.	Severe: Somewhat poorly drained; slow permeability.	Severe: Slow permeability.	Moderate: Somewhat poorly drained.	Severe: Slow permeability.
Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.
Moderate: Limited depth to rock.	Slight	Slight	Moderate: Limited depth to rock.	Slight	Severe: Limited depth to rock.
Moderate: Limited depth to rock.	Moderate: Limited depth to rock.	Moderate: Slope; limited depth to rock.	Moderate: Slope; limited depth to rock.	Slight	Severe: Limited depth to rock.
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Severe: Limited depth to rock.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Moderate: Slope	Moderate: Moderately slow permeability.	Moderate: Slope; moderately slow permeability.	Moderate: Slope; moderately slow permeability.	Slight	Moderate: Moderately slow permeability.
Moderate: Slope	Moderate: Moderately slow permeability.	Moderate: Slope; moderately slow permeability.	Moderate: Slope; moderately slow permeability.	Slight	Moderate: Moderately slow permeability.
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Moderately slow permeability.
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Moderately slow permeability.

TABLE 7.—*Estimated degree and kinds of limi-*

Soil series and map symbols	Cultivated crops	Homesite locations for homes of 3 stories or less [1]	Disposal of sewage effluent	Sewage lagoons	Lawns, landscaping, and golf fairways
MrD, MrD2, MrE2, MsD3.	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope; moderately slow permeability.	Severe: Slope	Severe: Slope
Ockley:					
OcA	Slight	Slight	Slight [2]	Severe: Permeable substratum.	Slight
OcB, OcB2	Slight	Slight	Slight [2]	Severe: Permeable substratum.	Slight
OcC, OcC2	Moderate: Slope; erosion hazard.	Moderate: Slope	Moderate: Slope [2]	Severe: Slope [2]	Moderate: Slope
OcD2	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
OsB	Slight	Slight	Severe: Moderately slow permeability seepage downslope.	Moderate: Slope	Slight
Pewamo:					
Pw	Slight	Severe: Very poorly drained; soft when wet.	Severe: Very poorly drained; moderately slow permeability.	Slight	Severe: Very poorly drained.
Randolph:					
RaA	Slight	Severe: Limited depth to rock.	Severe: Moderately slow permeability; limited depth to rock.	Severe: Limited depth to rock.	Moderate: Limited depth to rock.
Rarden:					
RdB2	Moderate: Erosion hazard.	Moderate: High shrink-swell potential; limited depth to shale.	Severe: Slow permeability.	Moderate: Slope; limited depth to shale.	Moderate; Limited depth to shale.
RdC2	Severe: Slope; erosion hazard.	Moderate: Slope; high shrink-swell potential.	Severe: Slow permeability.	Severe: Slope; limited depth to shale.	Moderate: Slope
RdE, RdF	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
Ritchey:					
RhB	Moderate: Erosion hazard.	Severe: Shallow to rock.[2]	Severe: Shallow to rock.[2]	Severe: Shallow to rock.[2]	Severe: Shallow to rock.[2]
RhC2	Severe: Slope; erosion hazard.	Severe: Shallow to rock.	Severe: Shallow to rock.	Severe: Shallow to rock; slope.	Severe: Shallow to rock.
RhE2	Severe: Slope; erosion hazard.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
Rock land, limestone:					
Rk	Severe: Steep slopes.	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope
Ross:					
Rn	Slight	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.
Shoals:					
Sh	Slight	Severe: Subject to flooding; soft when wet.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.
Sleeth:					
SlA	Slight	Moderate: Somewhat poorly drained.	Severe: Moderately slow permeability.	Severe: Permeable subtratum.	Moderate: Somewhat poorly drained.
SlB	Slight	Moderate: Somewhat poorly drained.	Severe: Moderately slow permeability.	Severe: Permeable substratum.	Moderate: Somewhat poorly drained.

See footnotes at end of table.

tations for land use planning—Continued

Streets and parking lots	Campsites		Athletic fields and other intensive play areas	Picnic and extensive play areas	Cemeteries and sanitary land fills
	Tents	Trailers			
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Slight	Slight	Slight	Slight	Slight	Slight.[2]
Moderate: Slope	Slight	Moderate: Slope	Moderate: Slope	Slight	Slight.[2]
Severe: Slope	Moderate: Slope	Severe: Slope	Severe: Slope	Moderate: Slope	Moderate: Slope.[2]
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Moderate: Slope	Slight	Moderate: Slope	Moderate: Slope	Slight	Slight.
Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained; moderately slow permeability.	Severe: Very poorly drained.	Severe: Very poorly drained.
Moderate: Somewhat poorly drained.	Moderate: Somewhat poorly drained.	Moderate: Somewhat poorly drained.	Moderate: Moderately slow permeability; limited depth to rock.	Moderate: Somewhat poorly drained.	Severe: Limited depth to rock.
Moderate: Slope	Severe: Slow permeability.	Severe: Slow permeability.	Severe: Slow permeability.	Slight	Severe: Slow permeability.
Severe: Slope	Severe: Slow permeability.	Severe: Slow permeability.	Severe: Slope; slow permeability.	Moderate: Slope	Severe: Slow permeability.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Shallow to rock.[2] Severe: Shallow to rock; slope. Severe: Slope	Severe: Shallow to rock.[2] Severe: Shallow to rock. Severe: Slope	Severe: Shallow to rock.[2] Severe: Shallow to rock; slope. Severe: Slope	Severe: Shallow to rock.[2] Severe: Shallow to rock. Severe: Slope	Severe: Shallow to rock.[2] Severe: Shallow to rock. Severe: Slope	Severe: Shallow to rock.[2] Severe: Shallow to rock. Severe: Slope.
Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope	Severe: Slope.
Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Slight	Slight	Severe: Subject to flooding.
Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Moderate: Somewhat poorly drained.	Moderate: Somewhat poorly drained.	Severe: Subject to flooding.
Moderate: Somewhat poorly drained. Moderate: Somewhat poorly drained; slope.	Moderate: Somewhat poorly drained. Moderate: Somewhat poorly drained.	Moderate: Somewhat poorly drained. Moderate: Somewhat poorly drained; slope.	Moderate: Moderately slow permeability. Moderate: Moderately slow permeability; slope.	Moderate: Somewhat poorly drained. Moderate: Somewhat poorly drained.	Severe: Somewhat poorly drained. Severe: Somewhat poorly drained.

TABLE 7.—*Estimated degree and kinds of limi-*

Soil series and map symbols	Cultivated crops	Homesite locations for homes of 3 stories or less [1]	Disposal of sewage effluent	Sewage lagoons	Lawns, landscaping, and golf fairways
Sloan:					
So	Moderate: Very poorly drained.	Severe: Subject to flooding; soft when wet.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.
Thackery:					
ThA	Slight	Slight	Slight [2]	Severe: Permeable substratum.	Slight
ThB	Slight	Slight	Slight [2]	Severe: Permeable substratum.	Slight
Westland:					
Wu	Slight	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Permeable substratum.	Severe: Very poorly drained.
Willette:					
Wv	Moderate: Very poorly drained.	Severe: Very poorly drained; subject to subsidence.	Severe: Very poorly drained.	Severe: Organic material.	Severe: Very poorly drained.

[1] Ratings also apply to commercial, institutional, and light industrial sites.

The procedure of this section is first to describe the soil series and then the mapping units in the series. Thus, to get full information on any one mapping unit, it is necessary to read the description of the unit and also the description of the soil series to which it belongs. As mentioned in the section "How This Survey Was Made," not all mapping units are of a soil series. For example, Borrow pit and Made land are miscellaneous land types and do not belong to a soil series; nevertheless, they, and the other land types in the county, are listed in alphabetic order along with the series.

An essential part of each soil series is the description of the soil profile, the sequence of layers beginning at the surface and continuing downward to the depths beyond which roots of most plants do not penetrate. Each soil series contains both a brief nontechnical and a detailed technical description of the soil profile. The nontechnical description will be useful to most readers. The detailed technical description is included for soil scientists, engineers, and others who need to make thorough and precise studies of soils.

In describing the soils, the soil scientists use Munsell notations (*8*) to indicate the color of a soil precisely. In this survey, the terms "light colored" and "dark colored" refer to the color of the surface layer of soils. Soils that have a surface layer with a color value of 4 or more are light colored; those that have a surface layer with a color value of less than 4 are dark colored. Unless otherwise stated the color is for a moist soil.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page on which each capability unit is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Many terms used in the soil descriptions and other sections are defined in the Glossary at the back of this survey and in the "Soil Survey Manual" (*8*).

Alexandria Series

The Alexandria series consists of deep, well-drained, sloping to steep soils that formed in clay loam or loam glacial till of Wisconsin age. These soils occupy uplands east of the Olentangy River in the eastern and south-central parts of the county.

A typical cultivated soil has a dark grayish-brown and brown silt loam surface layer that is strongly acid unless it has been limed. Below the surface layer is brown or dark-brown material in which the content of clay increases with increasing depth. The soil material is silty clay between depths of 19 and 45 inches. It is underlain by dark yellowish-brown and dark-brown, firm glacial till of clay loam texture. This till is generally so firm that it restricts the roots of plants and the movement of water.

These soils have a moderately deep root zone in most places. Available moisture capacity is generally medium, but is low in most of the steep eroded areas. Permeability is moderately slow.

Alexandria soils are cultivated in most places where slopes and erosion are not prohibitive. Crop response to fertilizer is good.

Typical profile of Alexandria silt loam, 12 to 18 percent slopes, in a pasture in Genoa Township, sec. 2, T. 3 N., R 17 W.:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; few roots; strongly acid; abrupt, irregular boundary.

A2—4 to 7 inches, brown (10YR 5/3) slit loam; weak, fine, subangular blocky structure; friable; few roots; strongly acid; gradual, irregular boundary.

tations for land use planning—Continued

Streets and parking lots	Campsites		Athletic fields and other intensive play areas	Picnic and extensive play areas	Cemeteries and sanitary land fills
	Tents	Trailers			
Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.	Severe: Subject to flooding.
Slight	Slight	Slight	Slight	Slight	Slight.
Moderate: Slope	Slight	Moderate: Slope	Moderate: Slope	Slight	Slight.[2]
Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.
Severe: Very poorly drained; soft and unstable.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.	Severe: Very poorly drained.

[2] Nearby wells, springs, or ponds may be contaminated by seepage of waste liquid.

B1—7 to 11 inches, brown (7.5YR 5/4) silty clay loam; moderate, fine, subangular blocky structure; firm; very strongly acid; clear, smooth boundary.

B21t—11 to 19 inches, brown (7.5YR 4/4) clay loam; moderate, medium and fine, subangular blocky structure; firm; thin continuous clay films on ped surfaces; very strongly acid; gradual, smooth boundary.

B22t—19 to 33 inches, dark-brown (7.5YR 4/4) silty clay; strong, medium, subangular blocky structure; firm; moderate continuous clay films on ped surfaces; strongly acid; gradual, wavy boundary.

B23t—33 to 45 inches, brown (7.5YR 5/4) silty clay; weak, coarse, subangular blocky structure; firm; thin discontinuous clay films on vertical surfaces; medium acid; gradual boundary.

C1—45 to 52 inches, dark yellowish-brown (10YR 4/4) clay loam; massive; firm; mildly alkaline; weakly calcareous; gradual boundary.

C2—52 to 58 inches, dark-brown (7.5YR 4/4) clay loam with few, fine, distinct mottles of dark gray (10YR 4/1); massive; firm; some gravel; calcareous; gradual boundary.

C3—58 to 60 inches, dark yellowish-brown (10YR 4/4) loam; very pale brown (10YR 7/3) seams of lime; massive; firm; calcareous.

The AP horizon ranges from 4 to 8 inches in thickness. In many cultivated areas, the A2 horizon is missing. In some places the B horizon includes dark yellowish brown and has subhorizons of strong brown. Part of the B horizon is clay in some places. Clay makes up more than 35 percent of the clay-enriched horizon, though clay content is as low as 30 percent in some of the subhorizons. The depth to carbonates ranges from 27 to 55 inches. The C horizon is light clay loam and heavy loam in some places. Reaction ranges from medium acid to strongly acid in the A1 horizon and from strongly acid to extremely acid in the upper part of the B horizon. The pH values increase with depth in the lower part of the B horizon.

The Alexandria soils are the well drained member of a drainage sequence that includes the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, the poorly drained Condit soils, and the very poorly drained Pewamo soils. The Alexandria soils are most commonly adjacent to the Cardington soils, but they are also near the Bennington, Condit, and Pewamo soils in some areas. Alexandria soils are generally steeper than the soils nearby.

Alexandria silt loam, 6 to 12 percent slopes (AdC).—This soil is on short, sloping hillsides that border the major streams and some of the minor streams in the eastern part of the county. Included with this soil were some small areas of Cardington soils.

On this Alexandria soil, surface runoff is rapid, and the hazard of erosion is severe in cultivated areas. (Capability unit IIIe–1)

Alexandria silt loam, 6 to 12 percent slopes, moderately eroded (AdC2).—This soil has a thinner surface layer than the one described as typical for the Alexandria series. The surface layer is a mixture of original surface soil and the upper part of the subsoil. This soil crusts more easily than the uneroded Alexandria silt loams. Included with this soil were some small areas of moderately well drained Cardington soils.

Where this Alexandria soil is cultivated, the hazard of erosion is severe. (Capability unit IIIe–1)

Alexandria silt loam, 12 to 18 percent slopes (AdD).—This moderately steep soil occupies short breaks and hillsides along the drainageways in the eastern and south-central parts of the county.

On this soil, the hazard of erosion is very severe in cultivated areas unless surface runoff is controlled. (Capability unit IVe–1)

Alexandria silt loam, 12 to 18 percent slopes, moderately eroded (AdD2).—The surface layer of this soil is partly material from the original surface soil and partly material from the upper part of the subsoil. Tilth is poorer than that of the uneroded Alexandria silt loams.

In cultivated areas erosion is a very severe hazard unless surface runoff is controlled. (Capability unit IVe–1)

Alexandria silt loam, 18 to 25 percent slopes (AdE).—This steep soil occupies short breaks. It is generally thinner

297-845—69——4

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

Soil	Acres	Percent
Alexandria silt loam, 6 to 12 percent slopes	1,038	0.4
Alexandria silt loam, 6 to 12 percent slopes, moderately eroded	2,224	.8
Alexandria silt loam, 12 to 18 percent slopes	554	.2
Alexandria silt loam, 12 to 18 percent slopes, moderately eroded	1,793	.6
Alexandria silt loam, 18 to 25 percent slopes	357	.1
Alexandria silt loam, 18 to 25 percent slopes, moderately eroded	565	.2
Alexandria soils, 6 to 12 percent slopes, severely eroded	218	.1
Alexandria soils, 12 to 25 percent slopes, severely eroded	152	.1
Alexandria and Morley silt loams, 25 to 40 percent slopes, moderately eroded	2,246	.8
Algiers silt loam	192	.1
Bennington silt loam, 0 to 2 percent slopes	33,864	12.0
Bennington silt loam, 2 to 6 percent slopes	17,302	6.0
Bennington silt loam, 2 to 6 percent slopes, moderately eroded	760	.3
Bennington silt loam, shale substratum, 0 to 2 percent slopes	61	(1)
Bennington silt loam, shale substratum, 2 to 6 percent slopes	193	.1
Blount silt loam, 0 to 2 percent slopes	41,033	14.6
Blount silt loam, 2 to 6 percent slopes	7,263	2.6
Bonpas silty clay loam	214	.1
Borrow pit	186	.1
Cardington silt loam, 2 to 6 percent slopes	24,854	8.8
Cardington silt loam, 2 to 6 percent slopes, moderately eroded	4,659	1.7
Cardington silt loam, 6 to 12 percent slopes	1,830	.6
Cardington silt loam, 6 to 12 percent slopes, moderately eroded	2,597	.9
Casco-Fox loams, 12 to 25 percent slopes, moderately eroded	137	(1)
Colyer silt loam, 25 to 50 percent slopes	1,244	.4
Condit silt loam, 0 to 2 percent slopes	931	.3
Eel silt loam	2,722	.9
Fox loam, 0 to 2 percent slopes	106	(1)
Fox loam, 2 to 6 percent slopes	208	.1
Fox silt loam, 0 to 2 percent slopes	195	.1
Fox silt loam, 2 to 6 percent slopes	1,453	.5
Fox silt loam, 2 to 6 percent slopes, moderately eroded	484	.2
Fox silt loam, 6 to 12 percent slopes	96	(1)
Fox silt loam, 6 to 12 percent slopes, moderately eroded	705	.3
Fox silt loam, 12 to 18 percent slopes, moderately eroded	117	(1)
Genesee silt loam	2,128	.8
Genesee silt loam, shallow variant	208	.1
Gravel pit	41	(1)
Loudonville silt loam, 2 to 6 percent slopes	92	(1)
Loudonville silt loam, 6 to 12 percent slopes, moderately eroded	59	(1)
Loudonville silt loam, shallow variant, 25 to 50 percent slopes	125	(1)
Made land	533	.2
Marsh	45	(1)
McGary silt loam, 0 to 2 percent slopes	171	.1
Millsdale silty clay loam	825	0.3
Milton silt loam, 0 to 2 percent slopes	461	.2
Milton silt loam, 2 to 6 percent slopes	1,009	.4
Milton silt loam, 2 to 6 percent slopes, moderately eroded	436	.2
Milton silt loam, 6 to 12 percent slopes, moderately eroded	321	.1
Milton silt loam, 12 to 18 percent slopes, moderately eroded	150	.1
Morley silt loam 2 to 6 percent slopes	30,979	11.0
Morley silt loam, 2 to 6 percent slopes, moderately eroded	6,924	2.5
Morley silt loam, 6 to 12 percent slopes	1,241	.4
Morley silt loam, 6 to 12 percent slopes, moderately eroded	5,385	1.9
Morley silt loam, 12 to 18 percent slopes	400	.1
Morley silt loam, 12 to 18 percent slopes, moderately eroded	1,777	.6
Morley silt loam, 18 to 25 percent slopes, moderately eroded	732	.3
Morley soils, 6 to 12 percent slopes, severely eroded	195	.1
Morley soils, 12 to 18 percent slopes, severely eroded	52	(1)
Ockley silt loam, 0 to 2 percent slopes	782	.3
Ockley silt loam, 2 to 6 percent slopes	1,372	.5
Ockley silt loam, 2 to 6 percent slopes, moderately eroded	146	.1
Ockley silt loam, 6 to 12 percent slopes	100	(1)
Ockley silt loam, 6 to 12 percent slopes, moderately eroded	167	.1
Ockley silt loam, 12 to 18 percent slopes, moderately eroded	113	(1)
Ockley silt loam, till substratum, 2 to 6 percent slopes	148	.1
Pewamo silty clay loam	58,618	20.8
Quarry	298	.1
Randolph silt loam, 0 to 2 percent slopes	208	.1
Rarden silt loam, 2 to 6 percent slopes, moderately eroded	34	(1)
Rarden silt loam, 6 to 12 percent slopes, moderately eroded	26	(1)
Rarden silt loam, 12 to 25 percent slopes	89	(1)
Rarden silt loam, 25 to 40 percent slopes	139	(1)
Ritchey silt loam, 2 to 6 percent slopes	347	.1
Ritchey silt loam, 6 to 12 percent slopes, moderately eroded	167	.1
Ritchey silt loam, 12 to 25 percent slopes, moderately eroded	195	.1
Rock land, limestone, steep	95	(1)
Ross silt loam	149	.1
Shoals silt loam	3,601	1.3
Sleeth silt loam, 0 to 2 percent slopes	710	3
Sleeth silt loam, 2 to 6 percent slopes	110	(1)
Sloan silty clay loam	3,458	1.2
Thackery silt loam, 0 to 2 percent slopes	383	.1
Thackery silt loam, 2 to 6 percent slopes	609	.2
Westland silty clay loam	2,551	.9
Willette muck	143	.1
Total	281,600	100.0

[1] Less than 0.05 percent.

to the underlying till material than are the less steep Alexandria soils. Included with this soil were some small eroded areas.

This soil is too steep for cultivation, and erosion is likely if a cover is not maintained. (Capability unit VIe–1)

Alexandria silt loam, 18 to 25 percent slopes, moderately eroded (AdE2).—This steep soil occupies breaks along the major drainageways in the eastern and south-central parts of the county. Its surface layer is a mixture of the original surface soil and the upper part of the subsoil. This soil is generally thinner to glacial till than are the less steep Alexandria soils.

Erosion is a severe hazard unless a protective cover is maintained. (Capability unit VIe–1)

Alexandria soils, 6 to 12 percent slopes, severely eroded (AeC3).—These soils have lost most of their original surface layer through erosion, and shallow gullies have formed in some places. Their surface layer is silty clay loam or clay loam and is more clayey than that of the uneroded or moderately eroded Alexandria soils. Included with these soils were some areas of a moderately eroded Alexandria silt loam and some small areas of moderately well drained soils.

These Alexandria soils have poor tilth and are difficult to work. The hazard of erosion is very severe in cultivated areas. (Capability unit IVe–3)

Alexandria soils, 12 to 25 percent slopes, severely eroded (AeE3).—The surface layer of these soils is mostly material from the subsoil, for practically all the original surface soil has been lost through erosion. The present surface layer is silty clay loam or clay loam. It is clayey, sticky, and difficult to work. Locally, shallow gullies are common.

Because this soil is steep and has rapid surface runoff, erosion is a continuing hazard unless a protective cover is maintained. (Capability unit VIe–1)

Alexandria and Morley silt loams, 25 to 40 percent slopes, moderately eroded (AmF2).—This mapping unit consists of Alexandria silt loam and Morley silt loam that were mapped together because they have similar limitations to use and need about the same management. Elsewhere in this section, a profile of a Morley silt loam is described as typical for the Morley series.

These soils are subject to erosion unless a protective cover is maintained. (Capability unit VIIe–1)

Algiers Series

The Algiers series consists of light-colored, poorly drained and somewhat poorly drained soils in small, widely scattered areas on flood plains. These soils formed in alluvium that washed from glacial till and outwash of Wisconsin age.

In a typical profile, the surface layer is dark grayish-brown silt loam about 9 inches thick. It is underlain by dark grayish-brown silty clay loam about 10 inches thick. These two layers are recently deposited alluvial material, and the layers under them are those of an older buried soil. The top layer of the buried soil is black silty clay that extends to a depth of 35 inches. It is underlain by 6 inches of grayish-brown clay loam that is prominently mottled with yellowish brown. Below this is gray and yellowish-brown silty clay loam that extends to a depth of 62 inches.

These soils have a seasonal high water table and are subject to flooding. Permeability is moderately slow, and available moisture capacity is high. The root zone is deep when the water table is low.

Algiers soils are cultivated in most places other than those that are frequently flooded.

Typical profile of Algiers silt loam in a level pasture in Brown Township, sec. 34, T. 5 N., R. 18 W.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; plentiful roots; slightly acid; abrupt, smooth boundary.

C1—9 to 19 inches, dark grayish-brown (10YR 4/2) silty clay loam; weak, medium and coarse, subangular blocky structure; few roots in upper part; medium acid; abrupt, irregular boundary.

IIA1b—19 to 35 inches, black (10YR 2/1) silty clay; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

IIB2gb—35 to 41 inches, grayish-brown (10YR 5/2) clay loam with many, medium, prominent mottles of yellowish brown (10YR 5/6); and common, fine, faint mottles of dark gray (10YR 4/1); tongues of material from the IIA1b horizon extend about 3 inches into this horizon; dark-gray coatings on vertical surfaces; weak, coarse, subangular blocky structure; firm; neutral; abrupt, irregular boundary.

IIC—41 to 62 inches, gray (10YR 5/1) and yellowish-brown (10YR 5/4 and 5/6) silty clay loam stratified with thin lenses of sandy material; massive; firm; neutral.

Depth to the dark-colored IIA1b horizon ranges from 12 to 26 inches. In many places restricted drainage is indicated by mottling immediately below the plow layer. The range in color includes dark grayish brown and dark gray in hues of 10YR and 2.5Y. Reaction ranges from slightly acid to neutral. The IIA1b horizon includes textures of clay, clay loam, and silty clay loam as well as silty clay. It is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The IIA1b horizon ranges from 10 to about 20 inches in thickness and is underlain by mottled gray or grayish-brown silty clay loam or clay loam.

The Algiers soils occur on flood plains with the well drained Genesee soils, the moderately well drained Eel soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils. Algiers soils are most commonly adjacent to the very poorly drained Sloan soils.

Algiers silt loam (As).—Seasonal wetness and the hazard of flooding are limitations to the use of this nearly level soil. Included with this soil in mapping were small areas that have a silty clay loam surface layer and some small areas that have a dark-colored surface layer. (Capability unit IIw–1)

Bennington Series

The Bennington series consists of light-colored, somewhat poorly drained soils that formed in clay loam or heavy loam glacial till of Wisconsin age. These soils are nearly level to gently sloping and occupy uplands in the eastern and south-central parts of the county.

A typical cultivated Bennington soil has a dark grayish-brown silt loam plow layer. The subsoil is more clayey than the plow layer and is light olive brown and olive brown in the upper part and dark yellowish brown to dark brown in the lower part. Internal drainage is restricted in this subsoil, as is indicated by mottling. The substratum consists of calcareous (5 to 20 percent carbonates) glacial till.

These soils have slow permeability in the subsoil and the substratum. They are seasonally saturated with free water for a significant period. Available moisture capacity is medium. The root zone is moderately deep in most places.

In this county most of the acreage of Bennington soils is used for cultivated crops. Crop response to fertilizer is good.

Typical profile of Bennington silt loam, 0 to 2 percent slopes, in a cultivated field in Berkshire Township, sec. 5, T. 4 N., R. 17 W.:

Ap—0 to 7 inches, dark grayish-brown (2.5Y 4/2) silt loam; weak, fine, granular structure; friable; strongly acid; abrupt, smooth boundary.

A2—7 to 8 inches, grayish-brown (2.5Y 5/2) silt loam with common, medium, distinct mottles of dark grayish brown (2.5Y 4/2) and yellowish brown (10YR 5/4), weak, fine, subangular blocky structure, and weak platy structure; friable; very strongly acid; abrupt, smooth boundary.

B1t—8 to 11 inches, light olive-brown (2.5Y 5/4) silty clay loam with many, medium, prominent mottles of brown (7.5Y 5/4); grayish-brown (2.5Y 5/2) coatings on ped surfaces; strong, medium, subangular blocky and angular blocky structure; firm; thin discontinuous clay films on ped surfaces; very strongly acid; clear, smooth boundary.

B21tg—11 to 16 inches, olive-brown (2.5Y 4/4) silty clay with common, medium, prominent mottles of strong brown (7.5Y 5/6); gray (2.5Y 5/1) coatings with common, fine, distinct mottles of dark yellowish brown (10YR 4/4) on ped surfaces; strong, medium, angular blocky structure; firm; moderate continuous clay films on ped surfaces; very strongly acid; gradual, smooth boundary.

B22tg—16 to 25 inches, dark yellowish-brown (10YR 4/4) silty clay loam with many, fine and medium, distinct mottles of brown (7.5YR 5/4) and strong brown (7.5YR 5/6), dark-gray (2.5Y 4/1) coatings; moderate, medium, angular blocky structure; very firm; thin continuous clay films on ped surfaces; very strongly acid in upper part, medium acid in lower part; gradual, smooth boundary.

B23tg—25 to 29 inches, dark-brown (10YR 4/3) silty clay loam with many, fine and medium, distinct mottles of yellowish brown (10YR 5/4 to 5/6); dark-gray (2.5Y 4/1) coatings; weak, medium, subangular blocky structure; firm; thin discontinuous clay films on ped surfaces; neutral; gradual, wavy boundary.

B31—29 to 33 inches, brown (10YR 4/3) silty clay loam with many, fine and medium, distinct mottles of light yellowish brown (10YR 6/4); gray (2.5Y 5/1) coatings; weak, medium, subangular blocky structure; firm, mildly alkaline; few small fragments of limestone; abrupt, wavy boundary.

B32—33 to 37 inches, dark-gray (10YR 4/1) and brown (10YR 4/3) silty clay loam; weak, coarse, subangular blocky structure; firm; mildly alkaline, intermittently calcareous.

C1—37 to 42 inches, dark-gray (10YR 4/1) and brown (10YR 4/3) light clay loam with light brownish-gray (10YR 6/2) seams of lime; massive; firm; calcareous.

C2—42 to 60 inches, brown (10YR 4/3), yellowish-brown (10YR 5/4), and dark yellowish-brown (10YR 4/4) light clay loam with light brownish-gray (10YR 6/2) seams of lime; massive; firm; calcareous.

The Ap horizon is dark grayish brown in hues of 10YR and 2.5Y. The thin A2 horizon described is not present in some cultivated areas but is commonly present in undisturbed areas. Depth to mottling ranges from 2 to 11 inches. The texture of the B horizon includes clay loam and light silty clay. The weighted average clay content of the clay-enriched horizon ranges from about 35 to 40 percent. Depth to carbonates ranges from 27 to 55 inches. The C horizon is heavy loam in some places. Its content of lime is relatively low; the calcium carbonate equivalent ranges from about 5 to 20 percent. Reaction ranges from strongly acid to medium acid in the surface horizon and from very strongly acid to strongly acid in the upper part of the B horizon. The pH values increase with depth in the B horizon.

The Bennington soils are somewhat poorly drained members of a drainage sequence that includes the well drained Alexandria soils, the moderately well drained Cardington soils, the poorly drained Condit soils, and the very poorly drained Pewamo soils. Bennington soils are most commonly adjacent to the Pewamo and Cardington soils, but in the central part of the county they are adjacent to the Blount soils. Bennington soils are similar to Blount soils but are more acid and are less clayey in their subsoil.

Bennington silt loam, 0 to 2 percent slopes (BeA).—This nearly level soil occupies uplands throughout the eastern half of the county. It is ponded in some places during wet periods. Included in mapping were some areas of the wetter, dark-colored Pewamo soils that are too small to be mapped separately and generally occupy the lowest positions in the landscape.

Erosion is not likely on this Bennington soil, but excess water is a concern unless adequate drainage is provided. (Capability unit IIw–3)

Bennington silt loam, 2 to 6 percent slopes (BeB).—Seasonal wetness is the major limitation to use of this gently sloping soil, but there is also an erosion hazard. Surface crusting is likely in cultivated areas. Included with this soil in mapping were some areas of the moderately well drained Cardington soils. These inclusions are in the steeper areas. (Capability unit IIw–3)

Bennington silt loam, 2 to 6 percent slopes, moderately eroded (BeB2).—This gently sloping soil has a surface layer that is a mixture of the original surface layer and the upper part of the subsoil. Its profile is otherwise similar to the one described as typical for the Bennington series. Included with this soil in mapping were small areas of Cardington soils. These inclusions are generally in the steeper areas. Locally, these areas are small and severely eroded.

On this Bennington soil, seasonal wetness is the major limitation to use, but there is also a moderate hazard of erosion. (Capability unit IIw–3)

Bennington silt loam, shale substratum, 0 to 2 percent slopes (BgA).—This soil has a shaly substratum at a depth of 45 to 60 inches. Its subsoil is more reddish than that of the soil described as typical for the Bennington series.

The erosion hazard is slight to none, but excess water limits use unless adequate drainage is provided. (Capability unit IIw–3)

Bennington silt loam, shale substratum, 2 to 6 percent slopes (BgB).—The profile of this soil differs from the one described as typical for the Bennington series by having a redder subsoil and a shale substratum at a depth of 45 to 60 inches. Included with this soil in mapping, generally on slopes of about 6 percent, were areas of moderately well drained soils.

Seasonal wetness is the primary limitation to the use of this Bennington soil, but erosion, especially on long slopes, is also a hazard. (Capability unit IIw–3)

Blount Series

The Blount series consists of light-colored, somewhat poorly drained soils that formed in clay loam or silty clay loam glacial till of Wisconsin age. These soils are nearly level to gently sloping and occupy broad areas on uplands in the western half of the county.

A typical Blount soil has a surface layer of dark grayish-brown silt loam 8 inches thick. The subsoil extends to a depth of about 24 inches and is mottled throughout. It is grayish-brown silty clay loam in the upper part, grayish-brown silty clay in the middle part, and dark-gray, gray, and grayish-brown silty clay in the lower part. At a depth of 24 inches is dark grayish-brown clay. The substratum consists of calcareous (20 to 35 percent carbonates) glacial till.

These soils have slow permeability in the subsoil and the substratum. They are seasonally saturated with free water for a significant period. Available moisture capacity is medium. The root zone is moderately deep in most places.

The Blount soils are extensive in this county. Most of the acreage is used for cultivated crops. These soils are slow to dry out in spring unless they have been adequately drained.

Typical profile of a Blount silt loam 3¼ miles north-northwest of Ostrander in Scioto Township (analytical data in table 10):

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, brown (10YR 5/3) when crushed; moderate, medium, granular structure; some material from the B1 horizon; friable; pH 7.4; abrupt, irregular boundary.

B1—8 to 11 inches, grayish-brown (10YR 5/2) silty clay loam with common, medium, prominent mottles of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6); weak, medium and coarse, subangular blocky structure; light brownish-gray (10YR 6/2) degradation surfaces; firm; pH 6.4; abrupt lower boundary.

B21t—11 to 16 inches, grayish-brown (10YR 5/2) silty clay with many, medium and coarse, prominent mottles of yellowish brown (10YR 5/6); moderate, medium, subangular and angular blocky structure; few light brownish-gray (10YR 6/2) degradation surfaces; firm; pH 5.2; clear lower boundary.

B22t—16 to 20 inches, grayish-brown (10YR 5/2) silty clay with many, medium and coarse, prominent mottles of yellowish brown (10YR 5/6); grayish-brown ped surfaces; strong, medium and coarse, angular and subangular blocky structure; gray (10YR 5/1) clay seams; firm; pH 6.0; clear lower boundary.

B23t—20 to 24 inches, dark-gray (10YR 4/1), gray (10YR 5/1), and grayish-brown (10YR 5/2) silty clay with many, medium, prominent mottles of yellowish brown (10YR 5/6); moderate, medium and coarse, angular and subangular blocky structure; very dark gray and dark-gray (10YR 3/1 and 4/1) clay seams; firm; pH 6.4; abrupt, wavy lower boundary.

B3–C—24 to 29 inches, dark grayish-brown (10YR 4/2) clay with common, medium, distinct mottles of yellowish brown (10YR 5/4); weak, medium and coarse, subangular blocky structure; gray (10YR 5/1) clay coatings; light-gray (10YR 7/2) segregated lime; yellow (10YR 7/8) rock residue; fragments of shale; firm; calcareous; gradual lower boundary.

C1—29 to 35 inches, brown (10YR 5/3) clay loam with few, fine, faint mottles of dark yellowish brown (10YR 4/4); weak, angular blocky structure; gray (10YR 5/1 and 6/1) vertical ped faces, grayish-brown (10YR 5/2) horizontal ped faces; dark-gray (10YR 4/1) clay seams; light-gray (10YR 7/2) lime seams; massive; firm; calcareous; gradual lower boundary.

C2—35 to 44 inches, brown (10YR 5/3) clay loam with few, fine, faint mottles of dark yellowish brown (10YR 4/4); weak, angular blocky structure; gray (10YR 5/1, 6/1) vertical ped faces, grayish-brown (10YR 5/2) horizontal ped surfaces; dark-gray (10YR 4/1) clay seams; light-gray (10YR 7/2) lime seams; few manganese stains; massive; firm; calcareous; gradual lower boundary.

C3 and C4—44 to 60 inches, dark grayish-brown (10YR 4/2) and brown (10YR 4/3) clay loam with few, fine, faint mottles of yellowish brown; gray (10YR 5/1 and 6/1) surface coatings; massive; firm; calcareous.

The A horizon ranges from 6 to 11 inches in thickness. The Ap horizon commonly is dark grayish brown (10YR 4/2). Depth to mottling ranges from 7 to 13 inches. The subsoil ranges from 15 to 20 inches in thickness. The B2 horizon includes a texture of clay, a hue of 2.5Y, values of 3 to 5, and chromas of 2 to 4. The underlying till material includes silty clay loam. Carbonates make up 20 to 32 percent of the underlying material. They occur at a depth of 24 to 36 inches.

The Blount soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained and well drained Morley soils and the very poorly drained Pewamo soils. Blount soils are adjacent to Morley and Pewamo soils. Along the boundary between soil associations 2 and 4, Blount soils are near Bennington soils. Blount soils formed in till having a higher content of lime than did the Bennington soils, and they have a more clayey and less acid subsoil.

Blount silt loam, 0 to 2 percent slopes (BlA).—This nearly level soil occupies broad areas adjacent to Pewamo soils, which are in depressions. Locally, this soil is ponded in some places during wet periods. Some of these ponded areas include small areas of Pewamo soils that are too small to map separately.

Excess water is a limitation to the use of this soil unless adequate drainage is provided. (Capability unit IIw–3)

Blount silt loam, 2 to 6 percent slopes (BlB).—Seasonal wetness is the major limitation to use of this gently sloping soil, but sheet erosion, especially on long slopes, is also a moderate hazard. The surface layer is highly susceptible to crusting. Included with this soil in mapping, particularly on slopes of about 4 to 6 percent, were some small areas of Morley soils. (Capability unit IIw–3)

Bonpas Series

This series consists of dark-colored, very poorly drained soils that formed in layers of water-worked silty and clayey material. These soils occur in swales, in depressional areas, and on nearly level terraces along streams.

A typical Bonpas soil has a very dark gray silty clay loam surface layer 9 inches thick. The subsoil extends to a depth of 43 inches. It is very dark gray silty clay loam in the upper part, dark-gray and yellowish-brown silty clay loam in the middle part, and very dark gray and yellowish-brown coarse silty clay loam in the lower part. Below the subsoil are thin layers of silty clay loam, sandy clay loam, and loamy fine sand that extend to a depth of 60 inches.

Bonpas soils have a high organic-matter content in the dark-colored surface layer. Permeability is moderately slow in the subsoil and substratum. Surface runoff is slow or ponded in most places. These soils have a seasonal high water table. Available moisture capacity is high. The root zone is deep when the water table is low.

These soils are not extensive in this county, but they are important for farming. Most areas have been drained and are used for cultivated crops, but the moderately slow permeability and wetness limit use even after these soils have been drained.

Typical profile of Bonpas silty clay loam about 5.5 miles northeast of Delaware in Troy Township, sec. 4, T. 6 N., R. 18 W.:

A11—0 to 4 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine, subangular blocky structure; firm; slightly acid; abundant roots; gradual boundary.

A12—4 to 9 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine, subangular blocky structure; firm; neutral; some roots; abrupt boundary.

B1g—9 to 14 inches, very dark gray (10YR 3/1) silty clay loam with few, fine, faint mottles of yellowish brown (10YR 5/4); moderate, medium, subangular blocky structure; very firm; neutral; very few roots; gradual boundary.

B21g—14 to 25 inches, dark-gray (10YR 4/1) and yellowish-brown (10YR 5/6) silty clay loam; strong, coarse, subangular blocky structure; firm; neutral; gradual boundary.

B22g—25 to 43 inches, very dark gray (N 3/0) and yellowish-brown (10YR 5/6 and 5/4) coarse silty clay loam; moderate, coarse, subangular blocky structure; firm; neutral; abrupt boundary.

C1—43 to 48 inches, yellowish-brown (10YR 5/8 and 5/6), grayish-brown (2.5Y 5/2), and dark-gray (N 4/0) silty clay loam; massive in place, weak, very thin, platy structure when disturbed; firm; neutral; gradual boundary.

C2—48 to 57 inches, gray (N 5/0) and yellowish-brown (10YR 5/8) sandy clay loam; massive; friable; neutral; abrupt boundary.

IIC3—57 to 60 inches, gray (N 5/0) and yellowish-brown (10YR 5/8) loamy fine sand; massive; very friable; mildly alkaline.

The A horizon ranges from 9 to 15 inches in thickness. It is typically very dark gray (10YR 3/1) but in some places is slightly darker. The B horizon ranges from 18 to 34 inches in thickness. Its texture generally is silty clay loam, but layers of silty clay less than 5 inches thick are present in the B horizon of some profiles. Depth to the C1 horizon ranges from 35 to 43 inches.

The Bonpas soils are adjacent to, or are near, the McGary soils, but they are more poorly drained than those soils.

Recent changes in classification place the Bonpas series on the inactive list. Soils that have been placed in the Bonpas series in Delaware County will be placed in the Patton series in later surveys.

Bonpas silty clay loam (Bo).—This nearly level soil can be cultivated safely only within a narrow range of moisture content. The surface layer is sticky if the soil is cultivated when wet. Surface crusting is not a hazard to seedlings.

Wetness, even in drained areas, is the main limitation to the use of this soil. (Capability unit IIw–2)

Borrow Pit

Borrow pit (Bp) is a land type consisting of areas from which soil material has been removed for use in building highways or in other construction. Generally, these areas are rectangular in shape and from 6 to 20 feet deep. In most places the soil material is clay loam till of Wisconsin age.

Most of these pits are filled with water and can be developed for wildlife and recreation. Areas not covered with water also can be developed as wildlife habitat by planting suitable vegetation. Plants should be used that can tolerate the calcareous soil and its poor tilth and moisture content. (Capability unit not assigned)

Cardington Series

The Cardington series consists of deep, light-colored, moderately well drained soils that formed in clay loam or loam glacial till of Wisconsin age. These soils are gently sloping and sloping. They occur on uplands east of the Olentangy River in the eastern and south-central parts of the county.

A typical cultivated Cardington soil has a dark grayish-brown, friable silt loam plow layer 7 inches thick. The subsoil extends to a depth of 31 inches. It is dark-brown, brown, or dark yellowish-brown clay to a depth of 29 inches and is brown clay loam below that depth. The underlying material is brownish glacial till of clay loam and loam texture. It is compact and firm enough to restrict the growth of plant roots and the movement of water.

These soils have moderately slow permeability and medium available moisture capacity in the root zone. The root zone is moderately deep in most places but is deep in others. The water table is high in winter and spring.

Cardington soils are extensive in the eastern part of this county. They are important for farming, and most of the acreage is used for cultivated crops.

Typical profile of a Cardington silt loam, in a cultivated field in Porter Township, sec. 3, T. 5 N., R. 16 W. (analytical data in table 10):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; abundant roots; strongly acid; abrupt, smooth boundary.

B1—7 to 12 inches, dark yellowish-brown (10YR 4/4) silty clay loam; dark grayish-brown (2.5Y 4/2) coatings on ped surfaces; moderate, medium, subangular blocky structure; firm; few roots; very strongly acid; gradual, smooth boundary.

B21t—12 to 16 inches, dark-brown (10YR 4/3) clay; dark-brown (10YR 3/3) coatings on ped surfaces; strong, medium, subangular blocky structure; very firm; few roots; thin discontinuous clay films on ped surfaces; very strongly acid; gradual, smooth boundary.

B22t—16 to 21 inches, brown (10YR 4/3) and dark yellowish-brown (10YR 3/4) clay with common, coarse, distinct mottles of grayish brown (2.5Y 5/2); strong, coarse and medium, subangular blocky structure; very firm; moderate continuous clay films on ped surfaces; strongly acid; gradual, smooth boundary.

B23t—21 to 29 inches, dark yellowish-brown (10YR 3/4) clay; very dark grayish-brown (10YR 3/2) coatings; few, medium, distinct mottles of grayish brown (10YR 5/2); weak, coarse and medium, subangular blocky structure; very firm; stains of manganese; thin continuous clay films on ped surfaces; slightly acid; gradual, wavy boundary.

B3t—29 to 31 inches; brown (10YR 4/3) clay loam; weak, medium and coarse, subangular blocky structure; firm; thin clay films on vertical surfaces; mildly alkaline; gradual, wavy boundary.

C1—31 to 36 inches, brown (10YR 4/3) clay loam; massive; firm; calcareous.

C2—36 to 46 inches, yellowish-brown (10YR 5/4) clay loam; massive; firm; calcareous.

C3—46 to 53 inches, dark yellowish-brown (10YR 4/4) clay loam; massive; firm; small fragments of shale; calcareous.

C4—53 to 63 inches, brown (10YR 4/3) loam; massive; firm; fragments of shale and a few pebbles; calcareous.

In undisturbed areas, there are a thin, dark-colored A1 horizon and an accompanying A2 horizon. Depth to mottling ranges from about 12 to 20 inches. Dominant colors in the B horizon are in hues of 10YR and 7.5YR. The texture of the B2 horizon includes clay loam, silty clay loam, and light silty clay. The weighted average clay content of the clay-enriched horizon ranges from about 35 to 40 percent. Depth to carbonates ranges from 27 to 55 inches. The C horizon is light clay loam and heavy loam in some places. Its content of lime is relatively low; the calcium carbonate equivalent ranges from about 5 to 20 percent. Reaction ranges from strongly acid to medium acid in the surface horizon and from very strongly acid to strongly acid in the upper part of the B horizon. The pH values increase with depth in the B horizon.

The Cardington soils are near, or are adjacent to, the well-drained Alexandria soils, the somewhat poorly drained Bennington soils, the poorly drained Condit soils, and the very poorly drained Pewamo soils. They are similar to Morley soils but are acid to a greater depth and have more shale and sandstone fragments in the underlying till. The Cardington soils formed in till having a lower content of calcium carbonates than did the Morley and Blount soils. Along the boundary between soil associations 2 and 4, it is difficult to distinguish Cardington soils from Morley soils.

Cardington silt loam, 2 to 6 percent slopes (CaB).—This soil is generally in good tilth, except in areas where the organic-matter content is low. Surface crusting is a concern in areas where the organic-matter content is low. Included in mapping were areas of the somewhat poorly drained Bennington soils.

This Cardington soil has moderate to rapid surface runoff and, in cultivated areas, the hazard of erosion is moderate. (Capability unit IIe–2)

Cardington silt loam, 2 to 6 percent slopes, moderately eroded (CaB2).—The plow layer of this soil normally is more clayey than that of the uneroded Cardington soils because material has been brought up from the subsoil. Crusting and sealing over are likely unless the organic-matter content is maintained at an optimum level. Included in mapping were small areas of the somewhat poorly drained Bennington soils. These inclusions occupy the lowest areas.

On this Cardington soil, surface runoff is moderate to rapid, and the hazard of erosion is moderate in cultivated areas. (Capability unit IIe–2)

Cardington silt loam, 6 to 12 percent slopes (CaC).—This sloping soil occupies short breaks and hillsides. In some places it is adjacent to steeper areas of Alexandria soils; in other places it lies above or between areas of Cardington silt loam, 2 to 6 percent slopes, and Bennington soils. Included in mapping were small areas of well-drained Alexandria soils and of somewhat poorly drained, gently sloping Bennington soils.

Tilth is generally good. Surface runoff is rapid and, in cultivated areas, erosion is a severe hazard unless a protective cover is maintained. (Capability unit IIIe–1)

Cardington silt loam, 6 to 12 percent slopes, moderately eroded (CaC2).—This soil has lost much of its original surface layer through erosion, and the present plow layer now contains some material from the subsoil. This soil is more shallow to the underlying limy till than Cardington silt loam, 2 to 6 percent slopes.

Generally, tilth is poor and the organic-matter content is low. The surface layer is highly susceptible to crusting. Surface runoff is rapid and, in cultivated areas, the hazard of erosion is severe unless a protective cover is maintained. (Capability unit IIIe–1)

Casco Series

The Casco series consists of well-drained soils that formed in loamy outwash underlain by limy sand and gravel at a depth ranging from 10 to 24 inches. These soils are moderately steep to steep, and they occupy kames and eskers that have undulating or irregular surfaces. Casco soils are mainly in the northwestern part of the county near Radnor.

In a typical profile, the surface layer is dark grayish-brown loam about 7 inches thick. The subsoil is 10 inches thick. It is yellowish-brown light clay loam in the upper part and dark-brown gravelly clay loam in the lower part. Below the subsoil is brown gravelly sand that contains lime.

Casco soils have moderately rapid permeability in the surface layer and subsoil and very rapid permeability in the substratum. Available moisture capacity is low. The root zone is shallow because the underlying sand and gravel are near the surface.

Casco soils occur in only small acreages in this county. Most areas are used for pasture. These soils are not important for farming, but they generally are good sources of sand and gravel.

Typical profile of a Casco loam in a wooded area in Radnor Township, sec. 4, T. 6 N., R. 20 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; abundant roots; neutral; abrupt, smooth boundary.

B1—7 to 10 inches, yellowish-brown (10YR 5/4) light clay loam; weak, fine, subangular blocky structure; friable; small amount of fine gravel; slightly acid; wavy boundary.

IIB2t—10 to 17 inches, dark-brown (7.5YR 4/4) gravelly clay loam; moderate, medium, subangular blocky structure; firm; thin, continuous clay films on ped surfaces; neutral; abrupt, irregular boundary.

IIC—17 inches +, brown (10YR 4/3 to 5/3) gravelly sand; single grain; loose; stratified; calcareous.

The Ap horizon is brown (10YR 4/3 to 5/3 and 7.5YR 4/3) in some places. In addition to 10YR and 7.5YR, the B horizon has a hue of 5YR in some areas. The range in reaction includes slightly acid in the upper part of the solum. In some places the lower part of the B horizon is weakly calcareous. Tongues of plastic material in the lower part of the B horizon make the boundary with the sand and gravel very irregular in some places. The underlying outwash is variably stratified and in places is not gravelly.

The Casco soils have a thinner subsoil than the Fox soils and are not as deep to sand and gravel.

Casco-Fox loams, 12 to 25 percent slopes, moderately eroded (CfE2).—Casco soils make up about 70 percent of this mapping unit, and Fox soils make up 30 percent. These soils occur in such a complex pattern that mapping each kind of soil is impractical. Except for the texture of the surface layer, the Fox soil has a profile similar to the one described as typical for the Fox series.

The soils in this mapping unit are better suited to permanent native pasture, or to trees, than they are to crops. Because the Casco soils are dominant, management of this mapping unit is that suitable for the Casco soils. (Capability unit VIe–2)

Colyer Series

The Colyer series consists of shallow, well-drained, light-colored soils that are very steep. These soils formed in residuum weathered from outcrops of acid, gray shale. They are in areas bordering Alum Creek and the Olentangy River and a few of its tributaries.

A typical wooded Colyer soil has a thin, black to very dark gray organic layer on the surface. Below this is very dark grayish-brown to dark grayish-brown, friable silt loam about 2 inches thick. The subsoil extends to a depth of about 13 inches. It is yellowish-brown and dark grayish-brown light silty clay loam in the top 2 inches and yellowish-brown silty clay loam below. The underlying material consists of yellowish-brown silty clay and shale fragments that make up 50 to 60 percent of the layer. At a depth of 17 inches is dark-gray, hard shale.

These soils have a shallow root zone. Permeability is moderate, and available moisture capacity is low.

Colyer soils are not extensive in this county, and they are not important for farming. Because these soils are very steep and droughty, almost all of the acreage remains wooded.

Typical profile of Colyer silt loam, 25 to 50 percent slopes, in a wooded area in Brown Township, sec. 24, T. 5 N., R. 18 W.:

O1—2¼ to ¼ inch, leaf litter from deciduous hardwoods.
O2—¼ inch to 0, black to very dark gray (10YR 2/1 to 3/1) organic material.
A1—0 to ½ inch, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; abundant roots; medium acid; gradual, smooth boundary.
A2—½ inch to 2 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; abundant roots; strongly acid; abrupt, wavy boundary.
B1—2 to 4 inches, yellowish-brown and dark grayish-brown (10YR 5/8, 4/2) light silty clay loam; weak, fine, subangular blocky structure; friable; abundant roots; very strongly acid; gradual, irregular boundary.
B21—4 to 9 inches, yellowish-brown (10YR 5/4) silty clay loam; weak, fine and medium, subangular blocky structure; firm; plentiful roots; fragments of shale; very strongly acid; gradual, irregular boundary.
B22—9 to 13 inches, yellowish-brown (10YR 5/6) shaly silty clay loam; weak, fine, subangular blocky structure; firm; few roots; grayish-brown (2.5Y 5/2) fragments of shale; very strongly acid; gradual, smooth boundary.
C—13 to 17 inches, yellowish-brown (10YR 5/6) very shaly silty clay; weak, fine, subangular blocky structure; some platiness inherited from shale; firm; grayish-brown (2.5Y 5/2) fragments of shale 50 to 60 percent, by volume; extremely acid; abrupt, smooth boundary.
R—17 inches +, dark-gray (N 4/0) Ohio shale.

The A horizon ranges from 1 to 4 inches in thickness. The B horizon is in hues of 7.5YR and 10YR. Its texture includes light silty clay. Weathered and disintegrated fragments of shale from the R horizon are evident in the B horizon. Depth to shale ranges from 15 to 20 inches.

The Colyer soils are most commonly adjacent to the somewhat poorly drained Bennington soils, the moderately well drained Cardington soils, and the very poorly drained Pewamo soils, but they are also near the well drained Alexandria soils in some areas. Colyer soils are much shallower and generally much steeper than the soils nearby.

Colyer silt loam, 25 to 50 percent slopes (ClF).—Use of this soil is limited mainly by very steep slopes. Erosion is a very severe hazard in bare areas. Included with this soil in mapping were some areas consisting of outcrops of raw shale. (Capability unit VIIs–1)

Condit Series

The Condit series consists of light-colored, poorly drained, deep soils that formed in clay loam or loam glacial till of Wisconsin age. These soils are nearly level or depressional. They occupy uplands east of the Olentangy River in the eastern and south-central parts of the county.

A typical Condit soil has a friable silt loam surface layer about 8 inches thick. It is very dark gray in the upper 2 inches and dark gray below. The dominantly gray, clayey subsoil extends to a depth of 45 inches and is mottled with strong brown or yellowish brown. Below the subsoil is variegated gray, yellowish-brown, and reddish-brown clay loam that is weakly calcareous. It is about 3 inches thick and is underlain by gray, yellowish-brown, yellowish-red, and strong-brown silty clay loam.

These soils have slow permeability and medium available moisture capacity. They have a seasonal high water table, and they dry out slowly in spring unless they are drained. These soils are seldom droughty because water seeps in from higher areas.

In this county, the total acreage of Condit soils is small. Drained areas are cultivated, but undrained areas generally are woodland.

Typical profile of a Condit silt loam in a level pasture in Kingston Township, sec. 12, T. 5 N., R. 17 W.:

A1—0 to 2 inches, very dark gray (10YR 3/1) silt loam; weak, fine, granular structure; friable; medium acid; abundant roots; gradual boundary.
A2—2 to 8 inches, dark-gray (10YR 4/1) silt loam with few, fine, distinct mottles of reddish brown (5YR 4/4); strong, medium, granular structure and weak, thin, platy structure in places; friable; strongly acid; plentiful roots; abrupt boundary.
B1g—8 to 14 inches, gray (10YR 5/1) fine clay loam with common, fine, prominent mottles of strong brown (7.5YR 5/6); moderate, medium, subangular blocky structure; firm; very strongly acid; common roots; gradual boundary.
B21tg—14 to 24 inches, dark-gray (10YR 4/1) silty clay with common, medium, prominent mottles of strong brown (7.5YR 5/6); strong, coarse, angular blocky structure; very firm; moderate continuous clay films on ped surface; strongly acid; few roots; numerous concretions of manganese; abrupt boundary.
B22tg—24 to 45 inches, gray (10YR 5/1) silty clay loam with common, medium, prominent mottles of yellowish brown (10YR 5/6); weak, medium and coarse, subangular blocky structure; firm; thin discontinuous clay films on ped surfaces; medium acid; very few roots; numerous concretions of manganese; gradual boundary.
C1—45 to 48 inches, gray (10YR 5/1), yellowish-brown (10YR 5/6), and reddish-brown (5YR 4/4) clay loam; massive; firm; mildly alkaline and weakly calcareous; numerous fragments of shale; gradual boundary.
C2—48 to 63 inches, gray (10YR 5/1), yellowish-brown (10YR 5/6), yellowish-red (5YR 4/6), and strong-brown (7.5YR 5/8) silty clay loam; massive; firm; mildly alkaline and calcareous; numerous fragments of shale.

In cultivated areas the A1 horizon is dark gray, gray, or grayish brown in hues of 10YR and 2.5Y. It has weak, thin, platy structure in places. In a few places the A and B horizons are grayish brown and mottling occurs immediately below the A1 horizon. The texture of the B2 horizon includes clay loam and light silty clay. The weighted average clay content of the clay-enriched horizon ranges from about 35 to 40 percent. Depth to carbonates ranges from 27 to 55 inches. The C horizon includes light clay loam and heavy loam. Its content of lime is relatively low, and the calcium carbonate equivalent ranges from about 5 to 20 percent. Reaction ranges from medium acid to strongly acid in the surface horizon and from very strongly acid to strongly acid in the upper part of the B horizon. The pH values increase with depth in the B horizon.

The Condit soils are the poorly drained member of a drainage sequence that includes the well drained Alexandria soils, the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, and the very poorly drained Pewamo soils. The Condit soils are grayer throughout than the Bennington soils and are lighter colored than the Pewamo soils.

Condit silt loam, 0 to 2 percent slopes (CnA).—This nearly level soil occupies small scattered areas that generally are adjacent to the somewhat poorly drained Bennington soils. Included in mapping were small areas of Bennington soils and small areas of the very poorly drained Pewamo soils.

This soil is sometimes ponded. Surface runoff is slow, and even in drained areas, wetness limits use. (Capability unit IIIw–2)

Eel Series

The Eel series consists of deep, moderately well drained, light-colored soils that formed in medium-textured sediments recently washed from Wisconsin glacial till and from soils formed from this till. These soils are nearly level and occur on bottom lands throughout the county.

A typical Eel soil has a dark grayish-brown, friable silt loam surface layer about 14 inches thick. This layer is underlain by brown light silty clay loam that extends to a depth of 28 inches. Below this, to a depth of 65 inches, is brown loam and fine sandy loam and grayish and brownish loam. Distinct mottles of grayish brown and yellowish brown are between depths of 28 and 52 inches.

The Eel soils have a deep root zone when the water table is low. Permeability is moderate, and available moisture capacity is high. The water table is high in winter and spring, and flooding is a hazard.

These soils occur in relatively small areas in this county, but they are important for farming.

Typical profile of an Eel silt loam, in a field in Genoa Township, sec. 36, T. 3 N., R. 17 W.:

Ap—0 to 14 inches, dark grayish-brown (10YR 4/2) or brown (10YR 4/3), crushed silt loam; weak, fine and medium, granular structure; friable; few roots; neutral; gradual, smooth boundary.

C1—14 to 28 inches, brown (10YR 4/3) light silty clay loam; weak, fine, subangular blocky structure; friable; few roots; neutral; gradual, smooth boundary.

C2—28 to 35 inches, brown (10YR 4/3) loam with few, fine, distinct mottles of grayish brown (10YR 5/2); moderate, fine, subangular blocky structure; firm; few roots; neutral; abrupt, smooth boundary.

C3—35 to 52 inches, brown (10YR 4/3) fine sandy loam with common, fine, distinct mottles of yellowish brown (10YR 5/6) and grayish brown (10YR 5/2); weak, fine, granular structure; friable; neutral; abrupt, irregular boundary.

C4—52 to 60 inches, dark-gray (10YR 4/1) and yellowish-brown (10YR 5/6) loam; massive; loose; lenses of sandy clay loam one-half inch thick; neutral; abrupt, smooth boundary.

C5—60 to 65 inches, very dark grayish-brown (2.5Y 3/2) loam; massive; firm; neutral; abrupt, irregular boundary.

The A horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The C1 horizon ranges from dark brown (10YR 4/3) to brown (10YR 5/3). The C2 horizon ranges from brown (10YR 4/3) to dark gray (10YR 4/1). In some places mottling is at a depth of as little as 18 inches. Texture of the C horizon includes silt loam and sandy clay loam, and there are lenses of sand or fine sandy loam in some places. Below a depth of 50 inches, the underlying material is sand and gravel in some places. Reaction ranges from neutral to mildly alkaline.

The Eel soils are adjacent to the well-drained Genesee soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils. Unlike Genesee soils, Eel soils are mottled. The Eel soils are less gray and less mottled than the Shoals and Sloan soils.

Eel silt loam (Ee).—Included with this nearly level soil in mapping were some areas of Genesee soils that were impractical to map separately.

Eel silt loam is easy to cultivate; good tilth is easily maintained. Although this soil is flooded in places, the flooding normally does not limit use of this soil for the crops commonly grown. Erosion is not likely. (Capability unit IIw-4)

Fox Series

The Fox series consists of light-colored, well-drained soils that formed in silty or loamy glacial outwash material of Wisconsin age. These soils are underlain by stratified, calcareous sand and gravel at a depth of 24 to 42 inches (fig. 4). They occupy benches and terraces along streams in the county and also an area of kames and eskers near the town of Radnor. These soils are generally high enough above streams to avoid flooding.

Figure 4.—**Profile of a Fox loam.**

In a typical profile, the plow layer is brown, friable silt loam 6 inches thick. It is underlain by a subsoil that extends to a depth of about 30 inches. The top 5 inches of the subsoil is reddish-brown silty clay loam, and the next layer is brown and reddish-brown gravelly clay loam. It is underlain by brown and dark reddish-brown gravelly clay loam, and by dark reddish-brown gravelly clay loam streaked light gray and white by lime. The underlying material is grayish-brown calcareous sand and gravel.

These soils have a moderately deep root zone. Available moisture capacity is medium to low, and permeability is moderate. These soils are droughty in dry periods. They are, however, very well suited to irrigation.

These soils are fairly extensive along the Scioto and Olentangy Rivers in this county, and they are important for farming.

Typical profile of a Fox silt loam about 2.5 miles southeast of Norton, Marlboro Township, sec. 14, T. 6 N., R. 19 W.:

Ap—0 to 6 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; abundant roots; neutral; abrupt, smooth boundary.

B1t—6 to 11 inches, reddish-brown (5YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; firm; few roots; neutral; gradual, smooth boundary.

IIB21t—11 to 16 inches, brown (10YR 4/3) and reddish-brown (5YR 4/3) gravelly clay loam; weak, fine, subangular blocky structure; firm; very few roots; abundant gravel; slightly acid; abrupt, smooth boundary.

IIB22t—16 to 25 inches, brown (10YR 4/3, 5/3) and dark reddish-brown (5YR 3/3) gravelly clay loam; strong, coarse, subangular blocky structure; firm; slightly acid; gradual boundary.

IIB3t—25 to 30 inches, dark reddish-brown (5YR 3/3) gravelly clay loam with light-gray (10YR 7/2) and white (10YR 8/2) streaks of lime; massive; firm, plastic; slightly effervescent; abrupt, irregular boundary.

IIC—30 inches +, grayish-brown (10YR 5/2) sand and gravel; single grain; loose; calcareous.

The A horizon is silt loam and loam. The Ap horizon ranges from brown (10YR 5/3) to dark grayish brown (10YR 4/2) in color and from 5 to 10 inches in thickness. A 3- to 5-inch platy A2 horizon of loam or silt loam texture is present in uncultivated areas, and in some cultivated areas there is a thin A2 below the Ap horizon. Depth to the highly calcareous stratified sand and gravel ranges from 24 to 42 inches.

The gravel in the B21 and B22 horizons makes up 15 to 50 percent of these horizons. In thickness, the B1 horizon ranges from 3 to 11 inches; the B2 from about 10 inches to 24 inches; and the B3 from 2 to 15 inches.

Texture of the IIB2 horizon includes clay. The B3 horizon is plastic, and the texture includes gravelly clay. Tongues of the B3 horizon are of varying lengths and extend into the substratum. Colors in the B horizon have a hue of 7.5YR in places. Color value in the upper horizon ranges from 3 to 5, and in the lower B from 2 to 4. Chroma range is 3 to 4 in the upper B horizon and 2 to 4 in the lower B. Through the entire solum the range in reaction is from neutral to strongly acid.

The Fox soils are adjacent to the Casco and Ockley soils in some places and to the Thackery, Sleeth, and Westland soils in other places. Fox soils are shallower to sand and gravel than the Ockley soils, but they are deeper than the Casco soils. Unlike the Thackery and Sleeth soils, Fox soils are not gray and mottled. Fox soils are light colored, whereas the Westland soils are dark colored.

Fox loam, 0 to 2 percent slopes (FlA).—The surface layer of this soil contains more sand and is coarser textured than the one in the profile described as typical for the Fox series. This soil generally is in very good tilth, and it does not crust so easily as the Fox silt loams. Included in mapping were small areas of the deep Ockley soils and some small areas of the moderately well drained Thackery soils.

Erosion is not likely on this Fox soil, but droughtiness is a limitation to use for crops. (Capability unit IIs–1)

Fox loam, 2 to 6 percent slopes (FlB).—This gently sloping soil has a surface layer that contains more sand and is coarser textured than the one in the profile described as typical for the Fox series.

This soil generally has good surface tilth. Surface runoff is medium to rapid, and the hazard of erosion is moderate in cultivated areas. (Capability unit IIe–1)

Fox silt loam, 0 to 2 percent slopes (FnA).—This nearly level soil occupies small, narrow areas on stream terraces and outwash plains. Included in mapping were small areas of the deeper Ockley soils.

On this soil there is little or no erosion hazard. Tilth generally is good, and the soil is easily worked, but droughtiness limits its suitability for crops. (Capability unit IIs–1)

Fox silt loam, 2 to 6 percent slopes (FnB).—This gently sloping soil occupies relatively long, broad stream terraces and outwash areas. Erosion is a moderate hazard in cultivated areas.

This soil generally is in good tilth and is easy to cultivate. (Capability unit IIe–1)

Fox silt loam, 2 to 6 percent slopes, moderately eroded (FnB2).—This soil is on long, broad terraces along streams and in outwash areas. Erosion has removed part of the original surface soil, and the plow layer now contains material that was subsoil. Because of the loss of organic matter, this soil generally is in poor tilth. The available moisture capacity of this soil is lower than that of the uneroded Fox silt loams.

This soil is subject to a continuing hazard of erosion. (Capability unit IIe–1)

Fox silt loam, 6 to 12 percent slopes (FnC).—This soil generally occupies rather short slopes. Because surface runoff is medium to rapid, the hazard of erosion is severe in cultivated areas unless a protective cover is maintained. This soil generally is in good tilth and is easily cultivated. (Capability unit IIIe–3)

Fox silt loam, 6 to 12 percent slopes, moderately eroded (FnC2).—This sloping soil occupies relatively short terrace breaks and short slopes in outwash areas. It has lost some of its original surface soil through erosion, and its present plow layer includes material from the subsoil. Past erosion has reduced the organic-matter content of the surface layer and has impaired tilth. It has also lowered available moisture capacity.

This soil is subject to severe erosion. (Capability unit IIIe–3)

Fox silt loam, 12 to 18 percent slopes, moderately eroded (FnD2).—This soil has lost all but 2 or 3 inches of its original surface soil through erosion, and the plow layer now includes material from the subsoil. Its surface layer is sticky when wet, and it crusts more easily than that of the uneroded Fox soils. In some places the surface layer is gravelly. The profile of this soil is thinner to sand and gravel but is otherwise similar to the one described for the Fox series.

On this soil, surface runoff is rapid and the hazard of erosion is very severe in cultivated areas. (Capability unit IVe–1)

Genesee Series

The Genesee series consists of light-colored, well-drained soils that formed in material washed from limy Wisconsin till and from soils formed on this till. The Genesee soils occupy flood plains throughout the county.

In a typical profile, the plow layer is dark grayish-brown silt loam. Because organic matter has accumulated in this layer, it is darker colored than the layer below. It is underlain by dark-brown, dark grayish-brown, and dark yellowish-brown loamy material that has little or no visible structure to indicate soil formation.

These soils have a deep root zone. Their water table fluctuates but is seldom within 3 or 4 feet of the surface. Permeability is moderate, and available moisture capacity is high. These soils are flooded occasionally.

The Genesee soils are important for farming in this county, though their total acreage is small.

Typical profile of a Genesee silt loam in cropland in Radnor Township, sec. 21, T. 5 N., R. 20 W.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine and medium, granular structure; friable; common roots; neutral; abrupt, smooth boundary.

C1—9 to 14 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; few roots; neutral; gradual, irregular boundary.

C2—14 to 19 inches, dark-brown (10YR 4/3) silt loam; weak, fine, subangular blocky structure; friable; few roots; neutral; abrupt, irregular boundary.

C3—19 to 43 inches, dark grayish-brown (10YR 4/2) and brown (10YR 4/3), crushed light silty clay loam; weak, fine, subangular blocky structure; friable; few roots; neutral; abrupt, irregular boundary.

C4—43 to 54 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; massive; friable; neutral.

The A horizon ranges from 9 to 14 inches in thickness. The C horizon ranges from a silt loam to light silty clay loam in the upper 30 inches. Sandy and clayey material occurs in layers below a depth of 43 inches. The Ap horizon is alkaline in some places. The C horizon is neutral to alkaline in the upper part and is neutral or calcareous in the lower part. Depth to bedrock generally is more than 10 feet.

The Genesee soils are adjacent to, or are near, the moderately well drained Eel soils, the somewhat poorly drained Shoals soils, the very poorly drained Sloan soils, and in some places, the well drained Ross soils. Genesee soils have a thinner, lighter colored surface layer than Ross soils.

Genesee silt loam (Gn).—This soil is nearly level; slopes are not more than 2 percent. Included with this soil in mapping were small areas of less well drained soils in alluvium.

Genesee silt loam has good structure in the surface layer and is easy to cultivate. Most areas are subject to only occasional flooding, though small areas are flooded frequently. These frequently flooded areas are better suited to permanent pasture than to row crops. On this soil the hazard of erosion is negligible. (Capability unit IIw-4)

Genesee Series, Shallow Variant

In some soil series, a variant is included. A variant has many of the characteristics of the series in which it is placed, but it differs in at least one important characteristic, which is indicated by its name. The acreage of a variant is not large enough to justify establishing a new series.

The Genesee, shallow variant, soil in this county is similar to typical soils of the Genesee series but is thinner to bedrock. The shallow variant is light colored and well drained. It occupies flood plains in the western part of the county.

A typical Genesee soil, shallow variant, has a dark grayish-brown silt loam plow layer about 5 inches thick. The subsoil is 12 inches thick. It is dark grayish-brown coarse silty clay loam and brown fine sandy loam in the uppermost 7 inches and brown coarse sandy loam in the lower 5 inches. Limestone bedrock is at a depth of 17 inches.

These soils have a shallow root zone. Available moisture capacity is low, and permeability is moderate.

In this county, the total acreage of the Genesee, shallow variant, soil is small. This soil is not important for farming.

Typical profile of Genesee silt loam, shallow variant, in a field about 1 mile west of Bellepoint in Concord Township:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; common roots; neutral; abrupt, smooth boundary.

B21—5 to 8 inches, dark grayish-brown (10YR 4/2) coarse silty clay loam; weak, fine, subangular blocky structure; friable; few roots, neutral; clear, smooth boundary.

B22—8 to 12 inches, brown (10YR 4/3) fine sandy loam; weak, fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

B23—12 to 17 inches, brown (10YR 4/3) coarse sandy clay loam; moderate, fine and medium, subangular blocky structure; firm; 5 percent rounded pebbles; neutral; abrupt, wavy boundary.

IIR—17 inches, light-gray (N 7/0) limestone bedrock.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3) in some places. The B horizon includes dark brown (10YR 4/3). Part of the B horizon is loam or silt loam in some places. The B horizon shows stratification. Reaction is mildly alkaline in some places. Rounded pebbles, 1 to 2 inches in diameter, make up from 0 to 10 percent of the soil mass. Depth to bedrock ranges from 15 to 20 inches.

Genesee silt loam, shallow variant (Go).—This nearly level soil is shallow to bedrock and droughty. Erosion is not likely, but flooding is a hazard. Included with this soil in mapping were some areas that have a surface layer that is thicker and darker colored than that of this soil. (Capability unit IIw-4)

Gravel Pit

Gravel pit (Gp) generally occurs on kames, eskers, and outwash terraces. These pits are normally 15 to 30 feet deep and, in many places on the outwash terraces, are in areas of Casco and Fox soils. Only a few are now mined. The gravel is generally in layers that vary in thickness and change in composition within short distances. Between the gravelly layers are sandy ones that contain variable amounts of silty and clayey material. The gravel consists mainly of quartz and granite minerals, but there are smaller amounts of limestone and shale.

Because the soil has been disturbed by the mining operations, erosion is active in and around areas of Gravel pit. Silting occurs in nearby drainageways because the exposed soil material is unstable and subject to erosion. The soil material contains little organic matter and has low available moisture capacity, but sweetclover commonly establishes itself naturally if it is not disturbed by mining operations. (Capability unit not assigned)

Loudonville Series

The Loudonville series consists of moderately deep, light-colored, well-drained soils that formed in thin, acid glacial till of Wisconsin age and is underlain by sandstone bedrock. These soils occupy small, scattered areas on uplands in the eastern part of the county.

A typical cultivated Loudonville soil has a brown silt loam plow layer. The subsoil is more clayey than the surface layer, and it contains fragments of sandstone in the lower part. Both the surface layer and the subsoil are strongly acid or very strongly acid unless these soils have been limed. Light yellowish-brown sandstone is at a depth of about 32 inches.

Loudonville soils have a moderately deep root zone and moderate permeability. Available moisture capacity is low. These soils are droughty.

Loudonville soils occupy a small acreage in the county, but they are important to farming.

Typical profile of a Loudonville silt loam in cropland, in Harlem Township, sec. 30, T. 3 N., R. 16 W.:

Ap—0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; plentiful roots; strongly acid; abrupt, wavy boundary.

B1—8 to 13 inches, brown (7.5YR 4/4) silt loam; moderate, fine and medium, granular structure; friable; few roots; strongly acid; gradual, smooth boundary.

B21t—13 to 18 inches, brown (7.5YR 4/4) silty clay loam; weak, medium, subangular blocky structure; friable; few roots; thin, patchy clay films on ped surfaces; very strongly acid; gradual, smooth boundary.

B22t—18 to 26 inches, brown (7.5YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; thin continuous clay films on ped surfaces; very strongly acid; abrupt, irregular boundary.

IIB3—26 to 32 inches, brown (7.5YR 4/4) silty clay loam; massive; friable; very strongly acid; fragments of sandstone; abrupt, irregular boundary.

IIR—32 inches +, light yellowish-brown (10YR 6/4) sandstone bedrock.

The Ap horizon ranges from 6 to 10 inches in thickness. It is dark brown in some places. Part of the B horizon is clay loam in some places. Clay makes up as much as 36 percent of the B horizon in some places. The B horizon ranges from 17 to 33 inches in thickness and from very strongly acid to medium acid. In addition to 7.5YR, it has a hue of 10YR in some places. Depth to sandstone bedrock ranges from 20 to 42 inches.

The Loudonville soils are adjacent to, or are near, the Alexandria, Cardington, and Bennington soils, but they formed in thinner till than those soils. Loudonville soils are not gray or mottled as are the Cardington and Bennington soils.

Loudonville silt loam, 2 to 6 percent slopes (LoB).—This gently sloping soil generally has good surface structure. The surface is likely to crust in areas where organic-matter content is low.

On this soil, surface runoff is moderate to rapid and the hazard of erosion is moderate. (Capability unit IIe–2)

Loudonville silt loam, 6 to 12 percent slopes, moderately eroded (LoC2).—This sloping soil has lost some of its original surface soil through erosion, and its plow layer is partly material from the subsoil. The profile of this soil is thinner than the one described as typical for Loudonville series.

Where this soil is cultivated, soil structure and tilth are generally poor, and surface runoff is rapid enough to create a severe hazard of erosion. (Capability unit IIIe–2)

Loudonville Series, Shallow Variant

The Loudonville, shallow variant, soils in this county are light colored, well drained, and shallow to sandstone bedrock. These soils occupy very steep side slopes adjacent to Duncan Run, Perfect Creek, and Big Walnut Creek.

In a typical profile, the plow layer is dark grayish-brown silt loam about 4 inches thick. The subsoil extends to a depth of about 13 inches and is brown light silty clay loam in the upper part and dark yellowish-brown clay loam in the lower part. Below the subsoil is sandstone bedrock. The soil material is acid throughout unless it has been limed.

These soils have a shallow root zone. Permeability is moderate, and available moisture capacity is low. These soils are very droughty.

In this county, these soils are in a small total acreage, and they are not important for farming.

Profile of Loudonville silt loam, shallow variant, 25 to 50 percent slopes, along Duncan Run about 1 mile southwest of the town of Duncan Run in Harlem Township, sec. 3, T. 3 N., R. 16 W.:

Ap—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, wavy boundary.

B21t—4 to 8 inches, brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; friable; 5 percent of horizon is thin fragments of sandstone less than 6 inches in length; thin, patchy clay films on ped surfaces; medium acid; clear, smooth boundary.

B22t—8 to 13 inches, dark yellowish-brown (10YR 4/4) clay loam; strong, coarse, subangular blocky structure; firm; 10 percent of horizon is thin fragments of sandstone less than 6 inches in length; thin, patchy clay films on vertical ped surfaces; strongly acid; abrupt, wavy boundary.

IIR—13 inches +, sandstone bedrock.

The Ap horizon is brown (10YR 4/3) or very dark grayish brown (10YR 4/2) in some places. The B horizon includes a hue of 7.5YR and texture of silty clay loam and loam. Reaction ranges from slightly acid to strongly acid in the surface horizon and from medium acid to very strongly acid in the B horizon. From 2 to 15 percent of the B horizon consists of thin fragments of sandstone. Depth to bedrock ranges from 13 to 20 inches.

Loudonville silt loam, shallow variant, 25 to 50 percent slopes (LsF).—This soil occupies short, very steep slopes where surface runoff is very rapid.

On this Loudonville soil, the hazard of erosion is very severe unless a protective cover is maintained. Most of the acreage is wooded. (Capability unit VIIe–1)

Made Land

Made land (Ma) consists mostly of fill material that has no true profile. In most areas the soil material has been disturbed and changed by earthmoving operations. The material generally is calcareous clay loam that is a mixture of subsoil and a small amount of the original surface soil. A few areas have been topdressed with several inches of original surface soil that helps in establishing and maintaining a good vegetative cover.

Made land has low organic-matter content and an imbalance of plant nutrients. The soil material varies considerably in short horizontal distances, and in some places, is in poor condition for plant growth. Graded areas are bare and are easily eroded, but grass can be established by mulching, fertilizing, and seeding. Trees that tolerate the calcareous soil and its poor tilth can be grown. (Capability unit not assigned)

Marsh

Marsh (Mc), a land type, consists of areas along streams and lakes. Periodically each year, these areas are covered by floodwater that deposits silty material on the bottom lands. The soil material is soft and sticky and has no discernible horizons. Most areas are covered with marsh grasses. Also growing in these areas are cattails, rushes, sedges, and willows. Marsh provides good habitat for waterfowl and for muskrats and mink. It is also a feeding and breeding place for fish, frogs, and insects. (Capability unit not assigned)

McGary Series

The McGary series consists of light-colored, somewhat poorly drained soils. These soils formed in moderately fine textured, limy sediments of Wisconsin age deposited on stream terraces by slack water.

A typical McGary soil has a dark grayish-brown silt loam plow layer about 8 inches thick. The subsoil extends to a depth of 41 inches and is mottled with yellowish brown, very dark gray, and grayish brown. It is dark-brown silty clay loam in the uppermost 3 inches. Below this, the subsoil is dark-gray and dark yellowish-brown silty clay. The movement of water is restricted in the subsoil. The subsoil is underlain by yellowish-brown and very dark gray silty clay loam and very dark grayish-brown gravelly clay loam.

These soils have a moderately deep root zone in most places. Permeability is slow, and available moisture capacity is medium within the root zone. The water table is seasonally high for a significant period.

The McGary soils occupy a small total acreage in this county.

Typical profile of a McGary silt loam in a meadow in Berlin Township, sec. 26, T. 4 N., R. 18 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; abundant roots; slightly acid; abrupt, smooth boundary.

B1—8 to 11 inches, dark-brown (10YR 4/3) silty clay loam with many, fine, faint mottles of yellowish brown (10YR 5/6) and very dark gray (10YR 3/1); moderate, medium, subangular blocky structure; firm; few roots; medium acid; gradual, wavy boundary.

B21tg—11 to 28 inches, dark-gray (10YR 4/1) silty clay with many, fine, prominent mottles of yellowish brown (10YR 5/6); gray (N 5/0) clay coatings; strong, medium, subangular blocky structure; very firm; few roots; few concretions of manganese and iron; slightly acid grading to neutral; gradual, wavy boundary.

B22tg—28 to 41 inches, dark yellowish-brown (10YR 4/4) silty clay with common, fine and medium, distinct mottles of yellowish brown (10YR 5/8) and grayish brown (10YR 5/2); gray (N 5/0) clay coatings; very dark gray (N 3/0) coatings along old root channels; strong, coarse, subangular blocky structure; very firm; neutral; abrupt, wavy boundary.

C1g—41 to 51 inches, yellowish-brown (10YR 5/6) silty clay loam with common, fine, faint and distinct mottles of yellowish brown (10YR 5/8), very dark gray (10YR 3/1), and gray (N 5/0); weak, thin, platy structure; firm; neutral; gradual, smooth boundary.

C2g—51 to 55 inches, very dark gray (10YR 3/1) silty clay loam with common, medium, faint and distinct mottles of yellowish brown (10YR 5/8) and dark gray (N 4/0); moderate, thin, platy structure; firm; neutral; gradual, smooth boundary.

C3—55 to 57 inches, very dark gray (10YR 3/1) silty clay loam; massive; firm; neutral; abrupt, irregular boundary.

IIC4—57 to 70 inches, very dark grayish-brown (10YR 3/2) gravelly clay loam; massive; firm; neutral.

The Ap horizon is dark grayish brown or grayish brown in hues of 10YR and 2.5Y. A thin, light brownish-gray, mottled A2 horizon occurs in some areas. The B horizon ranges from 22 to 35 inches in thickness. It includes a hue of 2.5Y and, in some places, is mottled with gray. Depth to the platy or laminated sediments ranges from 30 to 50 inches. Reaction ranges from strongly acid to slightly acid in the upper part of the B horizon. The pH values increase with depth in the lower part of the B horizon. The C horizon is calcareous in some places.

The McGary soils are associated with, or are adjacent to, the dark-colored, very poorly drained Bonpas soils.

McGary silt loam, 0 to 2 percent slopes (MgA).—This nearly level soil can be worked only within a narrow range of moisture content without clodding or puddling.

Seasonal wetness is a limitation to the use of this soil, but erosion is not likely. (Capability unit IIw-3)

Millsdale Series

The Millsdale series consists of moderately deep, dark-colored, very poorly drained soils that formed in moderately fine textured to medium-textured till. These soils are underlain by limestone at a depth ranging from 20 to 40 inches. They are level to nearly level, and they occupy uplands in the western part of the county.

In a typical profile, the surface layer is black or very dark gray, firm silty clay loam about 7 inches thick. The subsoil, to a depth of 19 inches, is black, very dark gray, and grayish-brown silty clay loam. Below this is yellowish-brown clay loam. Mottling of yellowish brown and gray begins at a depth of about 12 inches. At a depth of about 23 inches is a layer of gray silty clay that contains fragments of limestone. Gray limestone bedrock is at a depth of 30 inches.

These soils have a moderately deep root zone, and they are high in organic-matter content. Permeability is moderately slow. These soils are seasonally wet, particularly in winter and spring. They have a high moisture supplying capacity because of seepage from adjacent soils. Even in drained areas, wetness is a continuing hazard.

In this county most of the acreage of Millsdale soils is used for cultivated crops. Though their total acreage is not large, locally they are important for farming.

Typical profile of Millsdale silty clay loam in a meadow in Radnor Township, sec. 28, T. 6 N., R. 20 W.:

Ap—0 to 7 inches, black (10YR 2/1) or very dark gray (10YR 3/1) crushed silty clay loam; weak, fine, subangular blocky structure; firm; abundant roots; slightly acid; abrupt, smooth boundary.

B1g—7 to 9 inches, black (10YR 2/1) silty clay loam; moderate, medium, subangular blocky structure; firm; plentiful roots; slightly acid; abrupt, smooth boundary.

B21tg—9 to 12 inches, very dark gray (10YR 3/1) silty clay loam; strong, medium, subangular blocky structure; firm; thin continuous clay films on ped surfaces; neutral; gradual, smooth boundary.

B22tg—12 to 19 inches, grayish-brown (10YR 5/2) silty clay loam with common, medium, distinct mottles of yellowish brown (10YR 5/6); gray (10YR 5/1) coatings; strong, medium, subangular blocky structure; firm; moderate continuous clay films on ped surfaces; few roots; neutral; gradual, irregular boundary.

B23tg—19 to 23 inches, yellowish-brown (10YR5/6) clay loam with common, coarse, prominent mottles of gray (N 6/0); gray (N 6/0) coatings; strong, coarse, subangular blocky structure; firm; thin discontinuous clay films on vertical surfaces; mildly alkaline; gradual, irregular boundary.

IIB3g—23 to 30 inches, gray (N 5/0) silty clay with few, fine, prominent mottles of yellowish brown (10YR 5/6); massive; very firm; fragments of limestone; abrupt, smooth boundary.

IIR—30 inches +, gray (10YR 5/1) limestone bedrock.

The Ap horizon is very dark brown (10YR 2/2) in some places. The darker colors extend to depths between 10 and 14 inches. In some places the gleyed B horizon is heavy silty clay loam or light silty clay, and the clay content is more than 35 percent. The lower 2 to 10 inches of the B horizon generally developed in material weathered from limestone, but in some places it developed from till. Reaction ranges from neutral to medium acid in the Ap horizon. The pH values increase with depth.

The Millsdale soils are very poorly drained members of a drainage sequence that includes the well-drained Milton soils and the somewhat poorly drained Randolph soils. Millsdale soils are similar to the Pewamo soils, but unlike them, are underlain by limestone at a depth of 20 to 40 inches.

Millsdale silty clay loam (Mn).—This nearly level soil is ponded in some places, and wetness is its major limitation to use. This wet soil can be worked satisfactorily only within a narrow range of moisture content. The content of organic matter is high in this soil, and it generally has good structure and tilth. (Capability unit IIIw–3)

Milton Series

The Milton series consists of moderately deep, light-colored, well-drained soils that formed in limy glacial till of Wisconsin age and are underlain by limestone bedrock. These soils are nearly level to moderately steep and occupy uplands in the western part of the county.

A typical Milton soil has a silt loam surface layer that is very dark gray in the upper part and brown in the lower part. In cultivated areas the surface layer is dark grayish brown. The subsoil is more clayey than the surface layer and is dark yellowish brown and yellowish brown. The lower part of the subsoil formed in limestone residuum and contains many fragments of limestone. Limestone bedrock is at a depth of 26 inches.

These soils have a moderately deep root zone. Permeability is moderately slow, and available moisture capacity is medium.

The Milton soils are not extensive in this county, but they are important for farming.

Profile of a Milton silt loam in a wooded area in Radnor Township, sec. 21, T. 6 N., R. 20 W.:

A1—0 to 3 inches, very dark gray (10YR 3/1) silt loam; weak, very fine, granular structure; friable; abundant roots; slightly acid; abrupt, smooth boundary.

A2—3 to 7 inches, brown (10YR 5/3) silt loam; weak, very fine, subangular blocky structure; friable; plentiful roots; slightly acid; abrupt, wavy boundary.

B1—7 to 11 inches, dark yellowish-brown (10YR 4/4) silty clay loam; weak, fine, subangular blocky structure; friable; few roots; medium acid; gradual, irregular boundary.

B21t—11 to 18 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; very few roots; thin continuous clay films on ped surfaces; medium acid; abrupt, irregular boundary.

IIB22t—18 to 26 inches, dark yellowish-brown (10YR 3/4) silty clay; strong, medium, subangular blocky structure; firm; thin discontinuous clay films on ped surfaces; common fragments of limestone; neutral, but soil material near fragments of limestone is calcareous; abrupt, irregular boundary.

IIR–26 inches +, gray (10YR 5/1) limestone bedrock.

In cultivated areas there is a dark grayish-brown Ap horizon 6 to 10 inches thick. The B horizon includes a hue of 7.5YR and a texture of clay. Reaction ranges from slightly acid to strongly acid in the B1 horizon and the upper part of the B2 horizon. The pH value increases with depth. In some areas the part of the solum that developed from till lies directly over limestone. In a few areas there is a C horizon of calcareous till that is 2 to 7 inches thick and has a high content of limestone. In some places the lower part of the B horizon derived from limestone is clay 1 to 10 inches thick. Depth to limestone bedrock ranges from 20 to 40 inches.

The Milton soils are most commonly adjacent to the very poorly drained Millsdale soils and the somewhat poorly drained Randolph soils. Milton soils are not so gray and mottled as are the Randolph and Millsdale soils.

Milton silt loam, 0 to 2 percent slopes (MoA).—This nearly level soil occupies small areas on uplands and in many places is adjacent to Randolph and Millsdale soils.

On this soil surface runoff is slow to medium. The hazard of erosion is slight to none, but a moderately shallow depth to limestone is a limitation. This soil tends to be droughty. (Capability unit IIs–1)

Milton silt loam, 2 to 6 percent slopes (MoB).—This gently sloping soil occupies small areas on uplands and is adjacent to other Milton soils and to Randolph and Millsdale soils. Surface runoff from this soil is medium to rapid, and the hazard of erosion is moderate in cultivated areas. (Capability unit IIe–2)

Milton silt loam, 2 to 6 percent slopes, moderately eroded (MoB2).—The surface layer of this soil is a mixture of the original surface soil and the upper part of the subsoil. It is more clayey and sticky than the surface layer of the soil described as typical for the Milton series.

Where this soil is cultivated, it is susceptible to crusting and sealing. Surface runoff is medium to rapid, and erosion is a continuing hazard. (Capability unit IIe–2)

Milton silt loam, 6 to 12 percent slopes, moderately eroded (MoC2).—This soil occupies hillsides along drainageways. It is a little thinner to limestone than the soil described as typical for the Milton series. Included with this soil in mapping were small areas of the shallow Ritchey soils.

On this Milton soil, surface runoff is rapid and the hazard of erosion is severe in cultivated areas. (Capability unit IIIe–2)

Milton silt loam, 12 to 18 percent slopes, moderately eroded (MoD2).—This moderately steep soil is on hillsides adjacent to drainageways and streams. Because water erosion has removed much of the original surface soil, the surface layer is thin in untilled areas. In cultivated areas the surface layer contains material from the upper subsoil. Available moisture capacity is lower in this soil than in the other Milton soils.

This soil has rapid surface runoff and in cultivated areas a very severe hazard of erosion. (Capability unit IVe–1)

Morley Series

The Morley series consists of light-colored, moderately well drained and well drained soils on uplands. These soils formed in limy silty clay loam or clay loam glacial till of Wisconsin age. They are gently sloping to steep.

A typical Morley soil has a dark grayish-brown, friable silt loam surface layer 7 inches thick. The subsoil extends to a depth of 28 inches. It is brown silty clay loam in the upper part, dark-brown silty clay in the middle part, and dark-brown silty clay loam in the lower part. The underlying material is firm, calcareous, brownish glacial till of silty clay loam and clay loam texture. The clayey subsoil restricts the movement of water and the penetration of roots.

These soils have a moderately deep root zone and slow permeability. Available moisture capacity is generally medium in the root zone but is low in the steep eroded areas. These soils are saturated with free water for short periods, generally in spring and winter.

Morley soils occupy a large acreage in this county. They are important for farming, and most of their acreage is used for cultivated crops.

Profile of a Morley silt loam 3 miles northwest of town of Delaware in Troy Township (analytical data in table 10):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, dark brown (10YR 4/3) when crushed; some material from the B1 horizon; weak, fine, crumb structure; friable; abrupt, smooth boundary.

B1—7 to 11 inches, brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; grayish-brown (10YR 5/2) and brown (10YR 5/3) degradation surfaces; firm; clear, smooth boundary.

B21t—11 to 16 inches, dark-brown (10YR 4/3) silty clay with few, fine, faint mottles of grayish brown (10YR 5/2); strong, medium and coarse, subangular and angular blocky structure; faint degradation on vertical faces; very thin clay coatings on ped surfaces; very firm; gradual lower boundary.

B22t—16 to 21 inches, dark-brown (10YR 4/3) silty clay with few, fine, faint mottles of strong brown (7.5YR 5/6) and grayish brown (10YR 5/2); strong, medium and coarse, subangular and angular blocky structure; thin clay coatings on ped faces; very firm; abrupt, wavy lower boundary.

B3—21 to 28 inches, dark-brown (10YR 4/3) silty clay loam with many, medium, faint mottles of dark yellowish brown (10YR 4/4); moderate, medium and coarse, subangular blocky structure; thin clay seams on vertical ped faces, very thin seams on horizontal faces; firm; calcareous; gradual lower boundary.

C1—28 to 34 inches, dark grayish-brown (10YR 4/2) and dark yellowish-brown (10YR 4/4) silty clay loam; weak, coarse, angular blocky structure; gray (2.5Y 5/1) clay coatings and vertical clay seams; faint platy cleavage; firm; calcareous; gradual lower boundary.

C2—34 to 40 inches, dark grayish-brown (10YR 4/2), brown (10YR 4/3), and grayish-brown (10YR 5/2) clay loam with few fine, faint mottles of brown (7.5YR 5/3); weak, coarse, angular blocky structure; dark-gray (10YR 4/1), gray (10YR 5/1), and light-gray (10YR 6/1 and 7/1) coatings; strong platy cleavage; firm; calcareous; gradual lower boundary.

C3—40 to 46 inches, same as C2 horizon except slightly more firm in consistence.

C4—46 to 54 inches, dark grayish-brown (10YR 4/2) and brown (10YR 4/3) clay loam; massive; vertical irregular cleavage planes; gray (10YR 6/1) and light-gray (10YR 7/2) lime coatings; firm; calcareous; gradual lower boundary.

C5—54 to 60 inches, same as C4 horizon except cleavage planes are somewhat distinct.

The B2 horizon is clay in some places. Depth to the calcareous till ranges from 23 to 35 inches. The solum ranges from 23 to 31 inches in thickness. Some Morley soils have very little, if any, mottling in the B22 horizon.

The Morley soils are members of a drainage sequence that includes the somewhat poorly drained Blount soils and the very poorly drained Pewamo soils. Morley soils are less gray and less mottled than the Blount soils, and they are much lighter colored than Pewamo soils. It is difficult to separate Morley soils from Cardington soils along the boundary between soil associations 2 and 4. The Morley soils formed in till having a higher content of lime than did the Cardington soils. They are not leached so deeply as are the Cardington soils, and their profile contains less shale and sandstone than those soils.

Morley silt loam, 2 to 6 percent slopes (MrB).—This gently sloping soil occupies large irregular areas on undulating uplands. Included with this soil in mapping were some areas of the somewhat poorly drained Blount soils and some small pockets of the very poorly drained Pewamo soils.

This soil has medium to rapid surface runoff, and erosion is a moderate hazard in cultivated areas. In some areas, particularly on the lower slopes, this soil is wet later in spring than are areas on the upper slopes. (Capability unit IIe–2)

Morley silt loam, 2 to 6 percent slopes, moderately eroded (MrB2).—This gently sloping soil occupies large irregular areas on undulating uplands. Its surface layer is a mixture of original surface soil and the upper part of the subsoil. The surface layer contains more clay than that of the uneroded Morley soils, and it is more crusty and is subject to puddling. Included with this soil in mapping were small areas of the somewhat poorly drained Blount and the very poorly drained Pewamo soils.

Because this Morley soil has medium to rapid surface runoff, erosion is a severe hazard in cultivated areas. Some areas, generally those on the lower slopes, remain wet later in spring than other areas. (Capability unit IIIe–1)

Morley silt loam, 6 to 12 percent slopes (MrC).—This sloping soil is in rather long narrow areas on uplands near streams in the western half of the county. The surface runoff of this soil is rapid, and there is a severe hazard of erosion in cultivated areas. (Capability unit IIIe–1)

Morley silt loam, 6 to 12 percent slopes, moderately eroded (MrC2).—This soil has lost some of its original surface soil through water erosion, and where cultivated, its present surface layer is a mixture of the original surface soil and material from the subsoil. This soil is more difficult to plow than uneroded Morley soils, and it is more susceptible to crusting and puddling.

This soil has rapid surface runoff and, in cultivated areas, the hazard of erosion is severe. (Capability unit IIIe–1)

Morley silt loam, 12 to 18 percent slopes (MrD).—This moderately steep soil occupies small scattered areas along drainageways in the western half of the county. It generally is in areas between higher lying Morley soils or Blount soils and the wet, dark-colored Pewamo soils. This soil has a thinner surface layer than the one in the profile described as typical for the Morley series.

Where this Morley soil is cultivated, the hazard of erosion is very severe. (Capability unit IVe–1)

Morley silt loam, 12 to 18 percent slopes, moderately eroded (MrD2).—This soil occupies small scattered areas. Erosion has removed all but about 3 inches of the original surface layer and, in cultivated areas, the present plow layer is a mixture of about equal amounts of the original surface soil and subsoil material. Tilth generally is very poor.

Surface runoff from this soil is rapid and, in cultivated areas, the hazard of erosion is very severe. (Capability unit IVe–1)

Morley silt loam, 18 to 25 percent slopes, moderately eroded (MrE2).—This steep soil occupies scattered breaks along drainageways. It has a thin surface layer because erosion has removed part of the original surface soil.

Because this soil is steep and has very rapid surface runoff, erosion is a severe hazard unless a protective cover is maintained. Cultivated crops are not suitable. (Capability unit VIe–1)

Morley soils, 6 to 12 percent slopes, severely eroded (MsC3).—These soils have a silty clay loam or clay loam surface layer that is sticky when wet and can be worked only within a narrow range of moisture content. Locally, shallow gullies are common. Included with these soils in the mapping were some areas of moderately eroded Morley soils.

These severely eroded soils crust easily. Unless practices are used to improve the surface soil, seed germination is poor. Runoff is rapid, and the hazard of erosion is very severe in cultivated areas. (Capability unit IVe-3)

Morley soils, 12 to 18 percent slopes, severely eroded (MsD3).—These moderately steep soils have a surface layer of silty clay loam or clay loam that is sticky, crusts easily, and is difficult to till. Locally, shallow gullies are common. Included with these soils in mapping were small areas of moderately eroded or slightly eroded Morley soils.

These severely eroded Morley soils are not suited to cultivated crops, because of their slope and of past erosion. Seed germination is poor. Surface runoff is rapid or very rapid, and erosion is a very severe hazard unless a protective cover is maintained. (Capability unit VIe-1)

Ockley Series

The Ockley series consists of deep, well-drained, light-colored soils that formed in silty or loamy glacial outwash. These soils are underlain by stratified, limy sand and gravel. They are nearly level to moderately steep and occupy outwash valley trains or terraces throughout the county. These soils are above the normal level of floods.

A typical cultivated Ockley soil has a silt loam plow layer that is dark brown in the upper part and dark grayish brown in the lower part. This layer is friable and easy to till. The subsoil extends from a depth of 8 inches to 51 inches. It is dark reddish-brown silt loam to a depth of 14 inches and is dark reddish-brown to reddish-brown silty clay loam between depths of 14 and 19 inches. Below 19 inches the subsoil is dark reddish-brown and reddish-brown gravelly clay loam. Stratified sand and gravel is at a depth of 51 inches.

These soils have a deep root zone. Permeability is moderate, and available moisture capacity is high. The substratum is a good source of sand and gravel.

These soils occur in small areas and are not extensive in this county, but they are important for farming.

Profile of an Ockley silt loam in a cultivated field in Berkshire Township, sec. 4, T. 4 N., R. 17 W.:

Ap—0 to 4 inches, dark-brown (10YR 4/3) silt loam, weak, fine, granular structure; friable; abundant roots; neutral; gradual, wavy boundary.

Ap2—4 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; plentiful roots; neutral; abrupt, wavy boundary.

B1—8 to 14 inches, dark reddish-brown (5YR 3/3) silt loam; moderate, fine to medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

B21t—14 to 19 inches, dark reddish-brown (5YR 3/4) to reddish-brown (5YR 4/4) silty clay loam; moderate, medium to fine, subangular blocky structure; firm; thin nearly continuous clay films on ped surfaces; slightly acid; abrupt, irregular boundary.

IIB22t—19 to 31 inches, dark reddish-brown (5YR 3/3) to reddish-brown (5YR 4/3) gravelly clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; thin continuous clay films on ped surfaces; gradual, smooth boundary.

IIB3—31 to 51 inches, reddish-brown (5YR 4/3) gravelly clay loam; weak, coarse, subangular blocky structure; firm; many flat fragments of shale with water-rounded edges; slightly acid in upper part and neutral in lower part.

IIIC—51 to 60 inches, brown (10YR 5/3) sand and gravel; single grain; loose; stratified; calcareous.

The Ap horizon ranges from 4 to 8 inches in thickness. In some areas the B horizon has a hue of 7.5YR, and in some places the upper B horizon has a hue of 10YR. The B1 horizon is 5 or 6 inches thick. The B21t horizon ranges from 5 to 20 inches in thickness. The IIB22t horizon is sandy clay loam or gravelly clay loam and ranges from 12 to 30 inches in thickness. Reaction ranges from slightly acid to strongly acid in the B horizon. Depth to sand and gravel ranges from 42 to 60 inches.

The Ockley soils are the well drained members of a drainage sequence that includes the moderately well drained Thackery soils, the somewhat poorly drained Sleeth soils, and the very poorly drained Westland soils. Ockley soils are most commonly adjacent to Fox and Thackery soils. They are deeper to stratified sand and gravel than the Fox soils. The Ockley soils are less gray and mottled than the Thackery soils.

Ockley silt loam, 0 to 2 percent slopes (OcA).—Erosion is not likely on this nearly level soil, and there are few limitations to use. This soil generally has good tilth, and surface crusting is only a minor concern. Included in mapping were small areas of the shallow Fox soils and the moderately well drained Thackery soils. (Capability unit I-1)

Ockley silt loam, 2 to 6 percent slopes (OcB).—This gently sloping soil has medium to rapid surface runoff and is subject to a moderate hazard of erosion in cultivated areas. Included in mapping were a few areas of the moderately well drained Thackery soils that are too small to be mapped separately. (Capability unit IIe-2)

Ockley silt loam, 2 to 6 percent slopes moderately eroded (OcB2).—This gently sloping soil has lost about half of its original surface layer through erosion. It generally is lower in plant nutrients and organic-matter content and crusts more easily than the uneroded Ockley soils. The surface layer generally has good tilth.

This soil has medium to rapid surface runoff, and erosion is a moderate hazard in cultivated areas. (Capability unit IIe-2)

Ockley silt loam, 6 to 12 percent slopes (OcC).—This sloping soil generally occupies short, terrace breaks adjacent to flood plains and kames in outwash areas. Included in mapping were some small areas of the thinner Fox and Casco soils.

This Ockley soil generally has good tilth. Surface runoff is rapid, and the hazard of erosion is severe in cultivated areas. (Capability unit IIIe-1)

Ockley silt loam, 6 to 12 percent slopes, moderately eroded (OcC2).—The surface layer of this soil is thinner and contains less plant nutrients and organic matter than the surface layer of the uneroded Ockley soils. In cultivated areas the plow layer contains some material from the upper part of the subsoil. Included with this soil in mapping were some areas of the thinner Fox and Casco soils. These included areas are generally more gravelly in the surface layer than this soil.

On this soil, surface runoff is rapid and the hazard of erosion is severe in cultivated areas. (Capability unit IIIe-1)

Ockley silt loam, 12 to 18 percent slopes, moderately eroded (OcD2).—This moderately steep soil occupies undulating kames and short breaks on terraces. Its plow layer contains some material from the subsoil. This soil generally is thinner to the underlying sand and gravel and is more droughty than the other Ockley soils. Included with this soil were some gravelly areas of the thinner Fox and Casco soils.

This Ockley soil has rapid surface runoff because of its slope and erosion. The hazard of erosion is very severe in cultivated areas. (Capability unit IVe-1)

Ockley silt loam, till substratum, 2 to 6 percent slopes (OsB).—This soil generally occurs near the edges of outwash areas, where it formed in thin deposits of outwash over glacial till. It is similar to the soil described as typical for the Ockley series but has a compact till substratum at a depth of 36 to 45 inches. Unlike the typical soil, this soil is not suitable as a source of sand and gravel.

On this soil, surface runoff is medium to rapid and the hazard of erosion is moderate in cultivated areas. (Capability unit IIe–2)

Pewamo Series

The Pewamo series consists of deep, dark-colored, very poorly drained soils that formed in limy clay loam glacial till. These soils are nearly level or depressional and occupy uplands throughout the county. They also occur along some drainageways. In undulating areas, a distinct pattern of adjacent light-colored soils and the dark-colored Pewamo soils can be seen.

In a typical profile (fig. 5), the surface layer is very dark gray silty clay loam about 6½ inches thick. The subsoil extends to a depth of 74 inches. It is very dark grayish-brown silty clay loam in the upper part, dark-gray mottled silty clay in the middle part, and dark-gray and yellowish-brown mottled silty clay loam in the lower part. Below the subsoil is brown calcareous clay loam.

These soils have a deep root zone in drained areas. Permeability is moderately slow, and available moisture capacity is very high. These soils have a seasonal high water table for long periods unless they are artificially drained.

The Pewamo soils are extensive throughout this county, and they are very important for farming. Crops grow well in artificially drained areas.

Profile of Pewamo silty clay loam about 7 miles southeast of Sunbury, Trenton Township (analytical data in table 10):

Ap—0 to 6½ inches, very dark gray (10YR 3/1) silty clay loam; weak, fine and very fine, subangular blocky structure; firm; plentiful roots; neutral; abrupt, wavy boundary.

B1g—6½ to 13½ inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, fine, subangular blocky structure; firm to very firm; few roots; slightly acid; gradual, wavy boundary.

B21tg—13½ to 26½ inches, dark-gray (10YR 4/1) silty clay with common, fine, faint mottles of yellowish brown (10YR 5/8); moderate, medium, subangular blocky structure; very firm; very few roots; very dark grayish-brown (10YR 3/2) clay films along old root channels to a depth of 36 inches; neutral; diffuse, irregular boundary.

B22tg—26½ to 40½ inches, dark-gray (5Y 4/1) silty clay loam with common, fine, distinct mottles of dark yellowish brown; weak, medium and fine, subangular blocky structure; firm; neutral; diffuse, irregular boundary.

B3—40½ to 74 inches, yellowish-brown (10YR 5/8) silty clay loam with common, medium, distinct mottles of very dark gray (N 3/0); massive; firm; water table at depth of 58 inches; neutral; abrupt, irregular boundary.

C—74 to 95 inches, brown (10YR 4/3) clay loam with few, medium, faint mottles of dark gray (10YR 4/1); massive; firm; numerous fragments of shale; calcareous.

In thickness, the A horizon ranges from 5 to 14 inches, the B2 horizon ranges from 8 to 27 inches, and the B3 horizon ranges from 20 to 34 inches. Depth to calcareous till ranges from 35 to 75 inches. The B22tg horizon is fine silty clay loam or coarse clay in some places. In the western part of the county the C horizon contains numerous calcareous pebbles, and in the eastern part of the county it contains numerous fragments of shale. Reaction ranges from neutral to medium acid in the upper part of the profile. The pH values typically increase with depth.

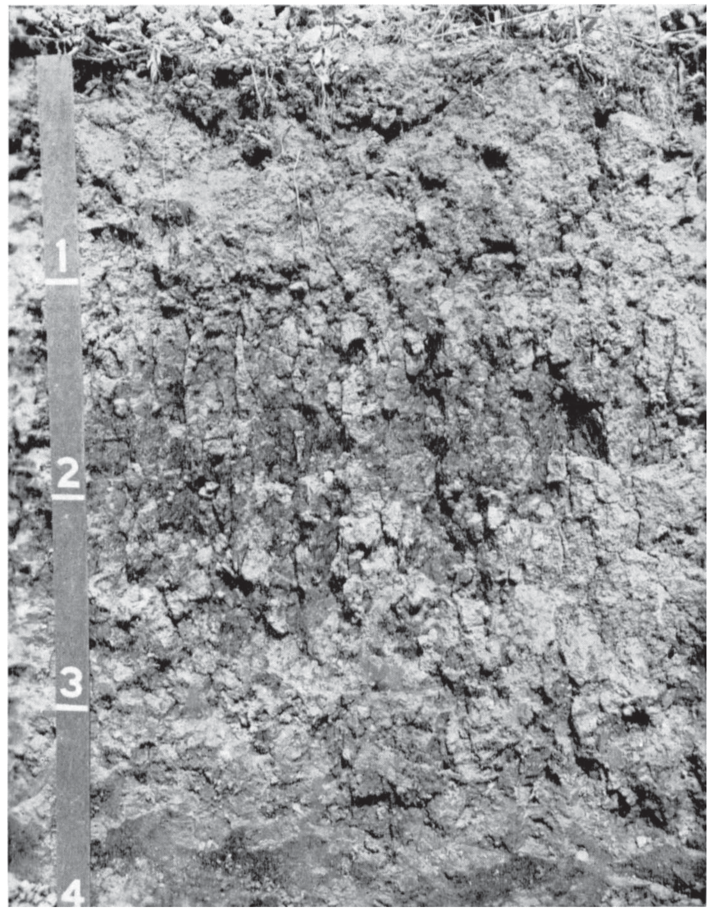

Figure 5.—**Profile of Pewamo silty clay loam.**

The Pewamo soils are near, or adjacent to, the Morley and Blount soils in the western part of the county, and the Cardington and Bennington soils in the eastern part. Pewamo soils are most commonly adjacent to the light-colored Blount and Bennington soils but occupy relatively lower positions.

Pewamo silty clay loam (Pw).—The surface layer of this nearly level soil is high in content of organic matter. If this soil is cultivated at the optimum moisture content it has good structure and tilth generally is good. Ponding is likely in undrained areas.

The erosion hazard is slight to none but wetness, even in adequately drained areas, is a moderate limitation. (Capability unit IIw–2)

Quarry

Quarry (Qu) consists of areas where limestone is relatively near the surface and is of quality suitable for mining. After the soil material overlying the limestone bedrock has been removed, limestone is taken for road construction, ground lime, buildings, and other industrial or agricultural uses. These areas generally are about 2 acres or more in size, but where mining continues, their size increases. Areas no longer used for mining can be planted to trees or other vegetation. The plants selected should be those that will grow in shallow, rocky, limy soil material that has poor tilth. Many areas can be developed and used for recreation and wildlife. Some of the larger areas are suitable for migratory waterfowl. (Capability unit not assigned)

Randolph Series

The Randolph series consists of light-colored, somewhat poorly drained soils that formed in relatively thin glacial till of Wisconsin age. These soils are moderately deep and are underlain by limestone bedrock. They are nearly level and occupy uplands in the western half of the county.

A typical wooded Randolph soil has a silt loam surface layer that is very dark grayish brown in the upper part and light brownish gray in the lower part. The subsoil extends from a depth of 7 inches to 32 inches, and it is mottled to a depth of 24 inches with yellowish and brownish colors. Silty clay loam that has a matrix color of grayish brown makes up the upper 3 inches of the subsoil. It is underlain by 6 inches of brown clay loam that is underlain, in turn, by 8 inches of dark-brown silty clay. Between depths of 24 and 32 inches is gray, yellowish-brown, strong-brown, and brown silty clay loam. Gray limestone bedrock is at a depth of 32 inches.

These soils have a moderately deep root zone and medium available moisture capacity. Permeability is moderately slow. These soils are saturated with free water for a significant period in winter and spring.

Randolph soils occur in only a small acreage in this county, and they are not important for farming.

Profile of a Randolph silt loam in a wooded area in Radnor Township, sec. 29, T. 6 N., R. 20 W.:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; common roots; medium acid; gradual, smooth boundary.

A2—3 to 7 inches, light brownish-gray (10YR 6/2) silt loam; weak, thin, platy structure; friable; few roots; medium acid; abrupt, smooth boundary.

B1—7 to 10 inches, grayish-brown (10YR 5/2) silty clay loam with few, medium, faint mottles of yellowish brown (10YR 5/4, 5/6); moderate, medium, subangular blocky structure; firm; few roots; medium acid; gradual, irregular boundary.

B21t—10 to 16 inches, brown (10YR 5/3) clay loam with few, fine, faint mottles of yellowish brown (10YR 5/6) and grayish brown (10YR 5/2); moderate, medium and coarse, subangular blocky structure; firm; thin continuous clay films on ped surfaces; very strongly acid; abrupt, irregular boundary.

B22t—16 to 24 inches, dark-brown (10YR 4/3) silty clay with common, medium, distinct mottles of strong brown (7.5YR 5/6) and grayish brown (10YR 5/2); strong, coarse, subangular blocky structure; firm; moderate, continuous clay films on ped surfaces; numerous shale fragments; gradual, irregular boundary.

IIB3t—24 to 32 inches, gray (10YR 5/1), yellowish-brown (10YR 5/6), strong-brown (7.5YR 5/6), and brown (10YR 5/3) silty clay loam; moderate, coarse, subangular blocky structure; firm; thin discontinuous clay films on vertical ped surfaces; common limestone fragments; calcareous; gradual, smooth boundary.

IIR—32 inches +, gray (10YR 5/1) limestone bedrock.

In cultivated areas the Ap horizon is typically dark grayish-brown (10YR 4/2) silt loam 6 to 9 inches thick. In some places the B2 horizon includes fine clay loam and clay. In addition to 10YR and 7.5YR, the B horizon has a hue of 2.5 in some places. The lower part of the B horizon, which was derived through weathering of the limestone bedrock, is neutral or mildly alkaline silty clay loam or silty clay 2 to 10 inches thick. In most places the B horizon lies directly on the limestone bedrock, but in a few places calcareous till not more than 8 inches thick is between the solum and the underlying bedrock. This till has a high content of calcium-carbonate and limestone fragments. Reaction ranges from neutral to medium acid in the A1 horizon and from slightly acid to very strongly acid in the upper part of the B horizon. The pH values increase with depth in the B horizon. Depth to limestone bedrock ranges from 20 to 40 inches, and it varies greatly within short horizontal distances.

The Randolph soils are adjacent to the well-drained Milton soils and the very poorly drained Millsdale soils. All of these soils are underlain by limestone bedrock.

Randolph silt loam, 0 to 2 percent slopes (RaA).—This soil occupies small scattered areas in the western part of the county. Erosion is not likely on this soil, but wetness is a limitation even in drained areas. Surface tilth generally is poor.

Because this soil is moderately shallow to bedrock, drainage by tile is difficult. (Capability unit IIw–3)

Rarden Series

The Rarden series consists of light-colored, well-drained soils that are mostly moderately deep to shale. These soils formed in material weathered from acid clay shale. They are gently sloping to steep, and they occupy uplands in the Hoover Reservoir area in the southeastern part of the county.

In a typical profile, the surface layer is brown silt loam about 5 inches thick. The subsoil is 23 inches thick. It is reddish-brown silty clay loam and clay in the upper part and brown, strong-brown, and light-gray clay in the lower part. Between depths of 28 and 34 inches is a layer of yellowish-brown and reddish-brown fragmented shale that is underlain by solid shale at a depth of 34 inches.

These soils have a moderately deep root zone and slow permeability. Available moisture capacity is medium. Because the clayey subsoil restricts the movement of water, these soils tend to be wet in winter and spring, and they dry out slowly in spring.

In this county most of the acreage of Rarden soils is wooded. These soils occupy a small acreage, and they are not important for farming.

Profile of a Rarden silt loam in a wooded area in Genoa Township, sec. 25, T. 3 N., R. 17 W.:

A1—0 to 2 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; abundant roots; strongly acid; gradual, wavy boundary.

A2—2 to 5 inches, brown (7.5YR 4/2) silt loam; moderate, fine, granular structure; friable; plentiful roots; strongly acid; abrupt, irregular boundary.

B21—5 to 7 inches, reddish-brown (5YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; few roots; very strongly acid; gradual, irregular boundary.

B22t—7 to 20 inches, reddish-brown (2.5YR 4/4) clay; strong, medium, prismatic structure that breaks to strong, medium, subangular blocky structure; very firm; few roots; very strongly acid; abrupt, irregular boundary.

B3—20 to 28 inches, brown (10YR 4/3), strong-brown (7.5YR 5/8), and light-gray (N 7/0) clay; weak, thin, platy structure; very firm; very strongly acid; abrupt, irregular boundary.

C—28 to 34 inches, yellowish-brown (10YR 5/8) and reddish-brown (5YR 4/4) fragmented shale; moderate, medium, platy structure; very strongly acid; abrupt, smooth boundary.

R—34 inches +, yellowish-brown (10YR 5/8) and reddish-brown (5YR 4/4) solid shale; moderate, medium, platy structure.

In thickness, the A1 horizon ranges from 1 to 3 inches, and the A2 horizon, from 3 to 5 inches. Part of the B horizon is silty clay in some places. The B21 horizon ranges from 2 to 3 inches in thickness, and the B22t horizon ranges from 6 to 13 inches. In some places the B3 horizon contains mottles of light gray (N 7/0) and gray (N 6/0). The quantity of shale fragments in the C horizon varies. Depth to the shale bedrock ranges from 19 to 40 inches but is less on the steeper slopes. Reaction ranges from medium acid to strongly acid in the A horizon and from very strongly acid to extremely acid in the B horizon. The pH values decrease with depth.

The Rarden soils are associated with the Bennington soils but are not so thick, gray, and mottled as those soils.

Rarden silt loam, 2 to 6 percent slopes, moderately eroded (RdB2).—This gently sloping soil has a plow layer that contains material from the upper subsoil. Much of the original surface layer has been lost through erosion. This soil generally is in very poor tilth, and it crusts easily.

On this soil, surface runoff is medium to rapid and the hazard of erosion is severe in cultivated areas. (Capability unit IIIe–2)

Rarden silt loam, 6 to 12 percent slopes, moderately eroded (RdC2).—This sloping soil has lost much of its original surface layer through erosion, and its plow layer is partly material from the subsoil. The present surface layer is slightly more clayey and sticky than that of the uneroded soil described as typical for the Rarden series. This layer generally is in poor tilth and crusts easily.

On this Rarden soil the hazard of erosion is very severe in cultivated areas. (Capability unit IVe–3)

Rarden silt loam, 12 to 25 percent slopes (RdE).—This soil has rapid to very rapid surface runoff, and the hazard of erosion is severe unless a protective cover is maintained. Slow permeability contributes to the rapid surface runoff. Included with this soil in mapping were small areas of soils that are shallow to shale. (Capability unit VIe–1)

Rarden silt loam, 25 to 40 percent slopes (RdF).—This steep to very steep soil is shallow to shale bedrock in some areas, and shale crops out in some places. It is generally thinner to shale than are the less steep Rarden soils.

This soil is too steep for cultivated crops, and the hazard of erosion is very severe in cultivated or disturbed areas. (Capability unit VIIe–1)

Ritchey Series

The soils in the Ritchey series are light colored and well drained. They formed in limy glacial till of Wisconsin age that is underlain by limestone bedrock at a shallow depth. Ritchey soils are gently sloping to steep and occur on hillsides adjacent to streams in the western part of the county.

A typical cultivated Ritchey soil has a dark grayish-brown, friable silt loam plow layer. The subsoil is more clayey than the plow layer and is dark brown in the upper part and brown in the lower part. A few fragments of limestone 1 or 2 inches in diameter occur in the lower part of the subsoil. Limestone bedrock is at a depth of 19 inches.

These soils have moderately slow permeability and a shallow root zone. Available moisture capacity is low, and these soils are very droughty.

In this county most of the acreage of Ritchey soils is used for crops and pasture. These soils are not extensive in the county and are not important for farming.

Profile of a Ritchey silt loam in a cultivated field about 2 miles northeast of Powell in Liberty Township, sec. 1, T. 3 N., R. 19 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; abundant roots; neutral; abrupt, irregular boundary.

B1—8 to 12 inches, dark-brown (10YR 4/3) silty clay loam; weak, fine, subangular blocky structure; firm; contains few roots; neutral; gradual, smooth boundary.

B2t—12 to 17 inches, dark-brown (7.5YR 4/4) silty clay; moderate, medium, subangular blocky structure; thin continuous clay films on ped surfaces; few fragments of limestone 1 or 2 inches in diameter; neutral; abrupt, smooth boundary.

IIB3—17 to 19 inches, brown (7.5YR 4/4) clay loam; moderate, medium and fine, angular blocky structure; firm; mildly alkaline; abrupt, irregular boundary.

IIR—19 inches +, light-gray (N 7/0) limestone bedrock.

The Ap horizon is dark brown (10YR 4/3) in some areas. Wooded or uncultivated areas have a dark grayish-brown (10YR 4/2) or very dark gray (10YR 3/1) A1 horizon 2 or 3 inches thick and an A2 horizon of brown (10YR 5/3), pale-brown (10YR 6/3), or yellowish-brown (10YR 5/4) silt loam 2 to 5 inches thick. The A2 horizon has weak, platy structure. The texture of the B2t horizon includes fine clay loam and clay. Depth to limestone ranges from 14 to 20 inches. The boundary with the limestone bedrock is wavy in some places. In some places the limestone contains narrow fissures, or cracks, and these are filled with brown, calcareous clay loam to a depth of 2 to 5 inches. The range in reaction includes slightly acid in the surface horizon and medium acid in the B1 horizon and the upper part of the B2t horizon. In some places the lower part of the B2t horizon and the IIB3 horizon is weakly calcareous.

The Ritchey soils are the shallow, well-drained members of a drainage sequence that includes the moderately deep, somewhat poorly drained Randolph soils and the very poorly drained Millsdale soils and in some places are adjacent to those soils. Ritchey soils are thinner and more brownish than the Randolph and Millsdale soils and, unlike those soils, are not mottled. Ritchey soils are similar to the moderately deep, Milton soils but are thinner than those soils.

Ritchey silt loam, 2 to 6 percent slopes (RhB).—This gently sloping shallow soil has medium to rapid surface runoff.

On this soil, the hazard of erosion is severe and tilth is generally poor in cultivated areas. Shallowness to bedrock limits this soil for most uses. (Capability unit IIIe–4)

Ritchey silt loam, 6 to 12 percent slopes, moderately eroded (RhC2).—This moderately eroded soil is thinner to bedrock and is more droughty than the soil described as typical for the Ritchey series. Tilth is generally poor in cultivated areas. Surface runoff is rapid, and erosion is a very severe hazard in cultivated or disturbed areas. (Capability unit IVe–2)

Ritchey silt loam, 12 to 25 percent slopes, moderately eroded (RhE2).—This moderately steep to steep, shallow soil has lost much of its original surface layer through erosion. This soil is very droughty.

This soil has very rapid surface runoff, and severe erosion is a continuous hazard unless permanent vegetation is maintained. (Capability unit VIe–2)

Rock Land, Limestone, Steep

Rock land, limestone, steep (Rk) consists of limestone outcrops with very shallow, very droughty soil material among them.

In this county this land type occupies a small total acreage, and it is not important for farming. A good protective cover is provided by trees. (Capability unit VIIs–1)

Ross Series

The Ross series consists of deep, dark-colored, well-drained soils in alluvium. These soils formed in medium-textured sediments that washed from calcareous glacial drift and from soils that formed in this material. They are nearly level and lie along some of the streams in the county.

In a typical cultivated Ross soil, very dark brown silt loam extends from the surface to a depth of 11 inches. It is underlain by 10 inches of very dark grayish-brown light silty clay loam. Between depths of 21 and 43 inches is dark-brown heavy silt loam. The material below a depth of 43 inches is dark yellowish-brown silty clay loam and light silty clay loam.

These soils have a deep root zone. Available moisture capacity is high, and permeability is moderate. In this county, Ross soils are subject to occasional flooding.

These soils are not extensive in this county, though they are important for farming. Most of the acreage is farmed intensively.

Profile of Ross silt loam in cropland in Radnor Township, sec. 21, T. 5 N., R. 20 W.:

Ap—0 to 6 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; few roots; neutral; abrupt, smooth boundary.

A11—6 to 11 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; few roots; neutral; clear, irregular boundary.

A12—11 to 21 inches, very dark grayish-brown (10YR 3/2) light silty clay loam; weak, medium and fine, subangular blocky structure; friable; neutral; gradual, smooth boundary.

A13—21 to 43 inches, dark-brown (10YR 3/3) heavy silt loam; weak, fine, subangular blocky structure; friable; neutral; gradual, smooth boundary.

C1—43 to 54 inches, dark yellowish-brown (10YR 4/4) silty clay loam; very dark grayish brown (10YR 3/2) along old root channels; massive; firm; neutral; gradual, smooth boundary.

C2—54 to 60 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; massive; firm; few fragments of shale; neutral.

The combined thickness of the Ap horizon and the A11 horizon ranges from 11 to 15 inches. To a depth of 20 inches or more these soils have a color value of 3 or less. The C horizon is silt loam and light silty clay loam in some places. Reaction ranges from neutral to mildly alkaline.

Ross soils are similar to the well-drained Genesee soils but are darker colored. They are darker colored and better drained than Eel soils. They are less gray and not mottled, in contrast to the somewhat poorly drained Shoals soils and the very poorly drained Sloan soils.

Ross silt loam (Rn).—This nearly level soil is generally in good tilth, and it can be worked throughout a fairly wide range of moisture content. Most areas are along the Scioto and Olentangy Rivers.

Although this soil is occasionally flooded in winter and early in spring, crops grown in summer are seldom damaged by flooding. The erosion hazard is slight to none. (Capability unit IIw-4)

Shoals Series

The Shoals series consists of deep, light-colored, somewhat poorly drained soils. These soils are nearly level, and they occupy flood plains throughout the county. They formed in alluvium washed from the uplands.

A typical Shoals soil has a surface layer of dark grayish-brown silt loam. The subsoil is dark grayish-brown heavy silt loam distinctly mottled with dark yellowish brown. Below the subsoil, to a depth of 60 inches or more, are strata of dark grayish-brown and very dark grayish-brown loam, silt loam, and gravelly loam distinctly mottled with yellowish brown.

Shoals soils have a deep root zone when the water table is low. Available moisture capacity is high, and permeability is moderately slow. Surface runoff is slow to very slow, and the surface is ponded in some places. The water table is high in winter and spring, and flooding is a hazard. In most places the level of the water table depends on the water level of the river or the streams nearby.

In this county the Shoals soils are extensive and are important for farming.

Profile of Shoals silt loam in a pasture in Trenton Township, sec. 1, T. 4 N., R. 16 W.:

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; strong, fine, granular structure; friable; abundant roots; few reddish stains; neutral; abrupt, smooth boundary.

A12—4 to 8 inches, dark grayish-brown (10YR 4/2) silt loam with common, fine, distinct mottles of brown (10YR 5/3); weak, fine, subangular blocky structure; friable; many roots; neutral; abrupt, smooth boundary.

B2—8 to 13 inches, dark grayish-brown (10YR 4/2) heavy silt loam with common, fine, distinct mottles of dark yellowish brown (10YR 4/4); moderate, medium, subangular blocky structure; friable; many roots; neutral; abrupt, smooth boundary.

C1—13 to 25 inches, dark grayish-brown (10YR 4/2) loam with many, medium, distinct mottles of yellowish brown (10YR 5/4, 5/6); weak, medium, subangular blocky structure; firm; few roots; neutral; gradual, smooth boundary.

C2—25 to 30 inches, very dark grayish-brown (10YR 3/2) silt loam with common, medium, distinct mottles of yellowish brown (10YR 5/4); weak, fine, subangular blocky structure; firm; neutral; clear, smooth boundary.

C3—30 to 60 inches +, dark grayish-brown (10YR 4/2) gravelly loam with few, coarse, distinct mottles of yellowish brown (10YR 5/6); massive; firm; neutral.

The A horizon ranges from 4 to 10 inches in thickness. Below a depth of about 24 inches, the soil material varies in texture, and the profile shows stratification. Part of the C horizon is light clay loam in some places. Sand and gravel commonly occur below a depth of 60 inches. In some places the C horizon is slightly acid. In addition to 10YR, the hue, to a depth of 40 inches, is 2.5Y in some places.

The Shoals soils are most commonly adjacent to the Genesee, Eel, and Sloan soils, but in some places, are adjacent to the Ross soils. Shoals soils are not so dark colored and poorly drained as the Sloan soils, but they are more poorly drained and are mottled nearer the surface than the Eel soils. The Shoals soils are much grayer than the Ross and Genesee soils.

Shoals silt loam (Sh).—This nearly level soil occurs in low areas along streams and rivers in the county. Included with this soil in mapping were small areas of Sloan soils that are too small to be mapped separately.

This soil is subject to flooding, and wetness is a limitation to use, even in drained areas. Establishing suitable drainage outlets is difficult on this soil because of its location. (Capability unit IIw-1)

Sleeth Series

The Sleeth series consists of somewhat poorly drained, light-colored soils that formed in silty or loamy glacial outwash material. These soils most commonly occupy terraces along streams but are generally above the normal level of floods.

A typical Sleeth soil has a plow layer of dark grayish-brown silt loam about 9 inches thick. The subsoil is more clayey than the plow layer and is dark grayish brown in the upper 6 inches and dark yellowish brown between depths of 15 and 38 inches. Between depths of 38 and 50 inches, the subsoil is very dark grayish-brown gravelly clay loam, distinctly mottled with dark yellowish brown. The material below a depth of 50 inches is dark yellowish-brown gravelly clay loam which grades to dark-brown gravelly sand. The underlying material is mottled with yellowish brown and grayish brown.

These soils have a deep root zone in most places when the water table is low. Permeability is moderately slow above the sand and gravel. Available moisture capacity is medium to high within the root zone, and these soils are seldom droughty. Except in drained areas, the water table is high for a fairly long period in winter and spring.

In this county, Sleeth soils occupy a small total acreage, but locally they are important for farming.

Typical profile of a Sleeth silt loam in a field about 2 miles southeast of Norton in Berlin Township, sec. 2, T. 4 N., R. 18 W.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; (rubbed color, 10YR 4/2); slightly acid; abrupt, smooth boundary.

B1t—9 to 15 inches, dark grayish-brown (10YR 4/2) fine silt loam; weak, medium, subangular blocky structure; friable; thin patchy clay films on ped surfaces; medium acid; clear, wavy boundary.

B21tg—15 to 22 inches, dark yellowish-brown (10YR 4/4) clay loam; weak, coarse, prismatic structure that breaks to moderate, medium, subangular blocky structure; firm; grayish-brown (10YR 5/2) coatings on peds; moderate continuous clay films on vertical surfaces, thin patchy clay films on horizontal surfaces; medium acid; gradual, smooth boundary.

B22tg—22 to 31 inches, dark yellowish-brown (10YR 4/4) fine clay loam with common, fine, distinct mottles of yellowish brown (10YR 5/6); moderate, medium, subangular and angular blocky structure; firm; grayish-brown (10YR 5/2) ped coatings; moderate continuous clay films on ped surfaces; few small pebbles; slightly acid; gradual, smooth boundary.

IIB31tg—31 to 38 inches, dark yellowish-brown (10YR 4/4) gravelly clay loam with many, medium, distinct mottles of grayish brown (10YR 5/2) and yellowish brown (10YR 5/6); grayish-brown coatings on peds; weak, coarse, subangular blocky structure; firm; thin continuous clay films on vertical surfaces; neutral; diffuse, smooth boundary.

IIB32g—38 to 50 inches, very dark grayish-brown (10YR 3/2) gravelly clay loam with common, medium, distinct mottles of dark yellowish brown (10YR 3/4 to 4/4); weak, coarse, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IIC1—50 to 56 inches, dark yellowish-brown (10YR 4/4) gravelly clay loam with many, fine and medium, distinct mottles of grayish brown (10YR 5/2) and yellowish brown (10YR 5/6); massive; firm; calcareous; abrupt, wavy boundary.

IIIC2—56 inches +, dark-brown (10YR 4/3) gravelly sand with common, coarse, distinct mottles of grayish brown (10YR 5/2); single grain; loose; calcareous.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2) in color. The texture of the B, or clay-enriched, horizon includes sandy clay loam and silty clay loam. In some places the B horizon is fine silt loam in the upper part and clay or gravelly clay in the lower part. The weighted average clay content of the upper 20 inches of the clay-enriched horizon is less than 35 percent. The content of gravel in the solum increases below a depth of 20 to 36 inches. In some places the clay-enriched horizon includes brown, dark brown, and olive brown and has a hue of 2.5Y. Grayish-brown or dark grayish-brown coatings and mottles occur immediately below the plow layer and throughout the solum in some places. Depth to calcareous, stratified gravel and sand ranges from 42 to 70 inches. In some places a calcareous layer of gravelly loam or clay loam, 4 to 15 inches thick, occurs above the loose, stratified, calcareous gravel and sand. Reaction ranges from neutral to medium acid in the Ap horizon and from slightly acid to strongly acid in the upper part of the B horizon. The pH values are lowest in the upper part of the B horizon, but they increase with depth in the lower part.

The Sleeth soils are the somewhat poorly drained members of a drainage sequence that includes the well drained Fox and Ockley soils, the moderately well drained Thackery soils, and the very poorly drained Westland soils. The Sleeth soils occupy higher positions than the Shoals soils, and they are finer textured than those soils.

Sleeth silt loam, 0 to 2 percent slopes (SlA).—Erosion is not likely on this soil, but wetness is a moderate limitation to use, even in drained areas. Included in mapping were small areas of dark-colored, very poorly drained Westland silty clay loam. (Capability unit IIw–3)

Sleeth silt loam, 2 to 6 percent slope (SlB).—On this gently sloping soil, seasonal wetness and a hazard of erosion are limitations to use. The hazard of erosion is moderate in cultivated areas. Included with this soil in the mapping were small depressional areas of very poorly drained Westland silty clay loam. (Capability unit IIw–3)

Sloan Series

The Sloan series consists of deep, very poorly drained, dark-colored soils on flood plains. These soils formed in material that washed from soils at a higher elevation.

In a typical profile, the surface layer (A horizon) is very dark gray silty clay loam 13 inches thick. Below the surface layer are alternating layers of grayish and brownish clay loam and silty clay loam that extend to a depth of 61 inches. Mottling and gleying begin at a depth of 20 inches and extend to 61 inches.

These soils have a deep root zone in drained areas. Permeability is moderately slow, and available moisture capacity is high. These soils are subject to overflow, and they have a seasonal high water table.

These soils occupy a fairly large acreage in this county, and they are important for farming.

Typical profile of Sloan silty clay loam in level cropland in Brown Township, sec. 28, T. 5 N., R. 18 W.:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine, granular structure; friable; plentiful roots; neutral; gradual, smooth boundary.

A1—7 to 13 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine, subangular blocky structure; friable; few roots; neutral; gradual, irregular boundary.

C1—13 to 20 inches, very dark grayish-brown (10YR 3/2) clay loam; moderate, fine and medium, subangular blocky structure; firm; few roots; neutral; gradual, irregular boundary.

C2g—20 to 32 inches, dark-gray (10YR 4/1) silty clay loam with common, fine, distinct mottles of reddish brown (5YR 4/3) and yellowish brown (10YR 5/4); moderate, medium, subangular blocky structure; firm; very few roots; contains layer of sandy clay loam one-half inch thick; neutral; abrupt, irregular boundary.

C3g—32 to 42 inches, dark-gray (10YR 4/1) clay loam with common, fine, distinct mottles of grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and yellowish red (5YR 4/6); massive; firm; numerous pebbles; neutral; gradual, irregular boundary.

C4g—42 to 49 inches, brown (10YR 4/3) silty clay loam with common, fine, distinct mottles of grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and yellowish red (5YR 4/6); massive; friable; neutral; gradual boundary.

C5g—49 to 58 inches, yellowish-brown (10YR 5/4) clay loam with common, fine, distinct mottles of gray (10YR 5/1); massive; friable; reddish-brown (10YR 5/4) streaks; neutral; gradual boundary.

C6g—58 to 61 inches +, grayish-brown (10YR 5/2) silty clay loam with common, fine, distinct mottles of yellowish brown (10YR 5/6) and very dark gray (10YR 3/1); massive; firm; calcareous.

The A horizon ranges from 10 to 16 inches in thickness. Part of the A horizon is silt loam in some places. The C horizon includes silt loam and loam in some places. Reaction ranges from slightly acid to mildly alkaline. The depth to calcareous soil material ranges from 35 to 60 inches. The pH values increase with depth in some places.

The Sloan soils occur with the Shoals, Eel, Genesee, and Ross soils on flood plains. Sloan soils are darker colored than Shoals, Eel, and Genesee soils. They are much wetter than the Ross soils.

Sloan silty clay loam (So).—This nearly level soil is generally wet unless adequate drainage is provided. Included in mapping were some slightly higher areas that are not so poorly drained.

Surface runoff on this soil is slow or ponded, and flooding is a limitation to use, even in drained areas. (Capability unit IIIw-4)

Thackery Series

The Thackery series consists of moderately well drained, light-colored soils on loamy outwash terraces that normally are above flood stage. These soils are underlain by stratified sand and gravel at a depth of 42 inches or more.

A typical Thackery soil has a dark-brown silt loam plow layer 7 inches thick. The subsoil is more clayey than the plow layer and is brown in the upper part and dark yellowish brown and brown in the lower part. Below a depth of 24 inches the soil material is distinctly more sandy and gravelly. Depth to stratified sand and gravel is 57 inches.

These soils have a deep root zone and high available moisture capacity. Permeability is moderate. These soils are seasonally saturated with free water for short periods in spring.

Thackery soils are not extensive in this county, but they are important for farming.

Profile of a Thackery silt loam in the Delaware Reservoir Wildlife Area, about 2.5 miles southeast of Norton in Marlboro Township, sec. 1, T. 6 N., R. 19 W.:

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

B1t—7 to 14 inches, brown (10YR 4/3) fine silt loam; weak, fine, subangular blocky structure; friable; common roots; thin, patchy clay films on ped surfaces; medium acid; gradual boundary.

B21t—14 to 24 inches, brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; firm; few roots; moderate continuous clay films on ped surfaces; slightly acid; gradual boundary.

IIB22t—24 to 30 inches, dark yellowish-brown (10YR 4/4) gravelly clay loam with common, fine, distinct mottles of yellowish brown (10YR 5/6); very dark gray (10YR 3/1) coatings; strong, coarse, subangular blocky structure; firm; moderate continuous clay films on ped surfaces; neutral; abrupt boundary.

IIB31t—30 to 45 inches, brown (10YR 4/3) sandy clay loam with common, medium, distinct mottles of yellowish brown (10YR 5/6); weak, coarse, thin, continuous clay films on vertical surfaces; subangular blocky structure; firm; neutral; abrupt boundary.

IIB32—45 to 51 inches, brown (10YR 4/3) sandy loam; massive; friable; neutral; gradual boundary.

IIC1—51 to 57 inches, brown (10YR 4/3) gravelly loam; massive; friable; weakly calcareous; abrupt, wavy boundary.

IIIC2—57 inches +, dark yellowish-brown (10YR 4/4), stratified sand and gravel; single grain; loose; calcareous.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 4/3). The clay-enriched horizon includes brown and dark brown and hues of 7.5YR. In some places the upper part of the clay-enriched horizon is clay loam or fine silt loam and the lower part is clay or gravelly clay. The weighted average clay content of the upper 20 inches of the clay-enriched horizon is less than 35 percent. The amount of gravel in the solum increases below a depth of 20 to 36 inches. Depth to mottling ranges from about 16 to 28 inches. Depth to calcareous, stratified gravel and sand is 42 to 70 inches. Reaction ranges from neutral to medium acid in the Ap horizon and from slightly acid to strongly acid in the upper part of the B horizon. The pH values increase with depth in the B horizon, though they are lowest in the upper part.

The Thackery soils generally are adjacent to the Fox, Ockley, and Westland soils. Thackery soils are slower in drying out in spring than are the well-drained Fox and Ockley soils. They are deeper to sand and gravel than the Fox soils, and they are mottled nearer the surface than the Ockley soils. Thackery soils are lighter colored and much better drained than the Westland soils.

Thackery silt loam, 0 to 2 percent slopes (ThA).—This nearly level soil occupies broad areas on stream terraces. In some places along Big Run its surface layer is thicker than is normal for Thackery soils. Surface tilth is generally good. Some slightly depressional or concave areas tend to stay wet longer than do the slightly convex areas. Included in mapping were some small areas of the poorly drained Westland soils. Most areas of this Thackery soil have slow surface runoff, and the erosion hazard is little or none. (Capability unit I-1)

Thackery silt loam, 2 to 6 percent slopes (ThB).—This gently sloping soil occupies the face of short breaks on terraces adjacent to flood plains and is subject to occasional flooding along the lower edges.

On this soil, surface runoff is rapid and the hazard of erosion is moderate in cultivated areas. (Capability unit IIe-2)

Westland Series

The Westland series consists of dark-colored, very poorly drained soils that formed in silty and loamy glacial outwash material. These soils are underlain by limy sand and gravel at a depth of 42 inches or more. They occur in nearly level to concave areas on stream terraces throughout the county.

A typical Westland soil has a plow layer of very dark gray silty clay loam 7 inches thick. Below this is very dark brown heavy silty clay loam. The subsoil is dark-gray clay loam and gravelly clay loam in which the content of gravel increases with increasing depth. Below a depth of 32 inches, the content of gravel is 15 to 20 percent or more. Below the subsoil is dark-gray sand and gravel that extends to a depth of 54 inches and has a high content of lime.

These soils have a deep root zone in drained areas. Available moisture capacity is high. The internal movement of water is moderately slow in the surface layer and the subsoil but is rapid in the underlying sand and gravel. These soils are saturated with free water for a significant period, generally in winter and spring.

In this county the Westland soils are in scattered areas on terraces along the streams, and they are important for farming.

Profile of Westland silty clay loam in a nearly level field in Troy Township, sec. 8, T. 6 N., R. 19 W.:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine and medium, subangular blocky structure; firm; abundant roots; neutral; abrupt, irregular boundary.

A1—7 to 12 inches, very dark brown (10YR 2/2) heavy silty clay loam; strong, medium and coarse, subangular blocky structure; firm; neutral; abrupt, irregular boundary.

IIB21tg—12 to 32 inches, dark-gray (10YR 4/1) clay loam to gravelly clay loam with many, coarse, distinct mottles of yellowish brown (10YR 5/6 to 5/8); very dark gray (10YR 3/1) on ped surfaces; weak, coarse, prismatic primary structure that breaks to moderate, coarse, subangular blocky secondary structure; firm; mildly alkaline; neutral; gradual, smooth boundary.

IIB22t—32 to 42 inches, dark-gray (N 4/0) gravelly clay loam; weak, coarse, subangular blocky structure; firm; mildly alkaline or weakly calcareous; abrupt, wavy boundary.

IIIC—42 to 54 inches, dark-gray (5Y 4/1) sand and gravel with few, fine, distinct mottles of yellowish brown (10YR 5/6); single grain; loose; violent effervescence with dilute hydrochloric acid; calcareous.

The A horizon ranges from 10 to 15 inches in thickness; the Ap horizon is 6 to 8 inches thick. The IIB21tg horizon is silty clay loam and silty clay in some places. Where the horizon is of silty clay texture, it is generally less than 5 inches thick. Depth to calcareous sand and gravel ranges from 42 inches to as much as 60 inches. The amount of gravel in the B horizon is variable. The range in reaction includes slightly acid in the upper part of the solum. The pH values remain constant or increase with depth.

The Westland soils are the very poorly drained members of a drainage sequence that includes the well drained Ockley soils, the moderately well drained Thackery soils, and the somewhat poorly drained Sleeth soils. The Westland soils are most commonly adjacent to the Sleeth soils, but they are also near the Bonpas soils in some areas. Westland soils are darker colored than Sleeth soils and have a coarser textured subsoil than Bonpas soils.

Westland silty clay loam (Wu).—This nearly level soil has a sticky, clayey surface layer that is difficult to till when wet. Surface runoff is slow or ponded, and wetness is a limitation to use, even in drained areas. (Capability unit IIw-2)

Willette Series

In the Willette series are very poorly drained, black organic soils that are 12 to 42 inches thick over mineral material. The organic material was formed from partly decomposed plant material from trees, fibrous grasses, sedges, and reeds. These soils occur in nearly level to concave areas. Undrained areas are swampy.

A typical Willette soil is black and mucky to a depth of about 24 inches. Below 24 inches is a very dark gray clay layer that restricts the movement of water. Below 28 inches is silty clay loam glacial till.

These soils have moderately rapid permeability in the muck and moderately slow or slow permeability in the underlying mineral material. Available moisture capacity is high. Because these soils are normally saturated with free water, they must be drained before they can be used for crops.

Willette soils occur only in a small acreage in this county, and they are not important for farming.

Profile of Willette muck in a level field in Radnor Township, sec. 33, T. 6 N., R. 20 W.:

1—0 to 7 inches, black (N 2/0) muck; weak, fine, granular structure; very friable; abundant roots; neutral; abrupt, smooth boundary.

2—7 to 24 inches, black (N 2/0) muck; massive; very friable; few roots; neutral; abrupt, smooth boundary.

IIC1—24 to 28 inches, very dark gray (10YR 3/1) clay; massive; very firm; neutral; abrupt, irregular boundary.

IIC2—28 to 42 inches, dark-gray (N 4/0) silty clay loam; massive; firm; calcareous.

The combined thickness of the muck, or organic layers, over the mineral material ranges from 12 to 42 inches. In some places there is a layer of peat between the muck and the mineral soil material.

In this county, Willette soils are adjacent to many soils but not consistently with any one kind. They occur in depressional areas of many different soils.

Willette muck (0 to 2 percent slopes) (Wv).—This is the only organic soil mapped in this county. Undrained areas are swampy and marshy. In drained areas the muck tends to subside because the organic material oxidizes. Soil blowing is likely in drained areas, but water erosion is not a hazard. This soil is highly productive under optimum management. (Capability unit IIIw-1)

Formation and Classification of Soils

This section lists the factors and processes of soil formation and discusses the effects they have had on the formation of soils in Delaware County. It also explains the current system of soil classification and places the soil series in higher categories. The soil series in this county, including a profile representative of each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

The five factors of soil formation are climate, plant and animal life, topography, parent material, and time. These five factors interact in the formation of any soil. The climate and plant and animal life have an effect on the parent material, and this effect is modified by time and topography. Normally the interaction of all of the factors determines the kind of soil that develops in any given place, but the relative importance of each factor differs from place to place. In some places one factor may dominate in the formation of a soil and determine most of its properties.

Parent material

Most of the soils in Delaware County formed in glacial till of Wisconsin age (fig. 6). The content of calcium carbonate in the till ranges from 20 to 35 percent in the western part of the county and from 5 to 20 percent in the eastern part. In some places the till is thick, but in other places it is thin over bedrock. The Morley, Blount, and other soils in the western part of the county contain fragments of limestone and are less deeply leached of carbonates than the Alexandria, Cardington, and other soils in the eastern part. The Morley, Blount, Alexandria, and Cardington soils are deep because they formed in thick deposits of till. The shallow Ritchey soils formed in thin deposits of till that are underlain by limestone.

Some of the soils in this county formed on glacial outwash terraces that contain much sand and gravel. The Casco and Fox soils are of this kind, and in many places they are good sources of sand and gravel. In other places the coarse-textured glacial outwash has been covered with silty and loamy outwash, and in these places the Ockley, Westland, and Sleeth soils developed.

In the eastern part of the county, the shale bedrock influences the soils. In the till parent material, the percentage of shale fragments is higher in the eastern part of the county than in the western part. Some soils in the eastern part of the county formed in residuum weathered from outcrops of shale. The Rarden soils are clayey because they formed from outcrops of clay shale. The Bennington soils, shale substratum, have inherited the reddish colors in the subsoil from the underlying mixed shale.

Some of the soils in the county are forming in material that washed from soils on uplands and was deposited on bottom lands. This is a continuing process, and these soils show little or no soil development. The Ross, Genesee, and Eel soils are forming in deep deposits of silty and loamy material. They are nearly neutral in reaction because their parent material washed from calcareous till material.

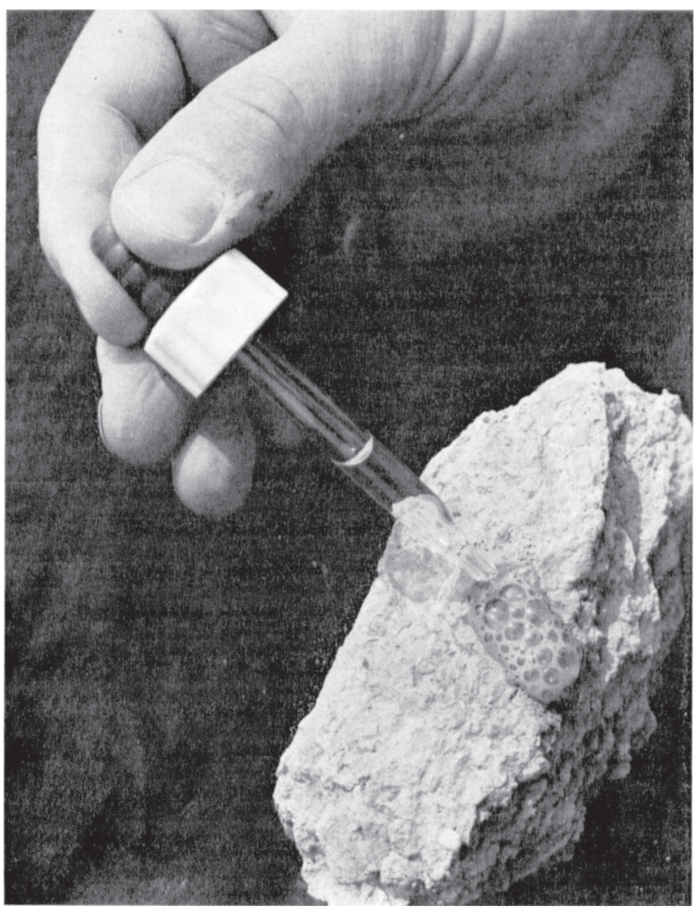

Figure 6.—**A ped from calcareous glacial till of Wisconsin age. Most of the soils in Delaware County are underlain by this material.**

Climate

The effects of climate on the development of soils can be observed in several ways in Delaware County. Rainfall and temperature have encouraged plant growth, and all the soils have a surface layer containing a significant amount of organic matter. The dark-colored surface layer of the Pewamo and Westland soils contains much organic matter. As a result of climate, most of the parent material in the county is weathered to at least a moderate depth. Frequent precipitation has supplied ample moisture for weathering and has leached soluble carbonates to a moderate depth in the Alexandria, Cardington, Morley, Blount, and other soils. Also, clay has been moved from the surface layer to the subsoil by water from the frequent rains. Evidence of such movement is the clay films in the subsoil of the Fox, Milton, and Ockley soils. In this county the structure of most soils is, at least partly, the result of freezing and thawing.

Plant and animal life

In addition to climate, vegetation is an active factor of soil formation. For a long period, hardwoods have been the dominant natural vegetation in Delaware County. Most of the soils of the uplands, such as the Bennington, Blount, Alexandria, and Morley, are light colored and acid, at least to a moderate depth. Dark-colored soils, such as the Pewamo, are in marshy swales where water had slowed the destruction of organic matter.

Insects, worms, tree roots, and small animals channel the soils for a considerable depth, and by so doing make them more permeable. Worms and ants mix the soil material considerably.

Time

The length of time the parent material has been in place and exposed to the active forces of vegetation and climate is important in the development of soils. In this county, glacial till parent material has been exposed to the factors of soil formation since the retreat of the last glaciers about 10,000 to 20,000 years ago. Except for the soil in alluvium and the residual soils, the soils of the county have had an equal time for soil formation. Obvious differences in soils, therefore, are the result of differences in profile development caused by differences in parent material, topography, and other soil-forming factors. The Colyer soils have a poorly developed profile because they have steep slopes where the soil erodes almost as fast as it forms. The weakly developed Eel, Ross, and Genesee soils developed in recently deposited material, and they receive new material in periodic floods. In these soils, profile development starts by the accumulation of organic matter in the surface layer, but this is interrupted by the next deposition of sediments.

Topography

Many of the differences in soils in this county are caused by differences in topography. For example, Alexandria, Cardington, and Bennington soils formed under similar conditions, except for natural drainage, and natural drainage depends mostly on topography. The well-drained Alexandria soils occupy slopes where surface and internal drainage are good. Cardington soils are in areas where the water table is seasonally high for brief but significant periods. The somewhat poorly drained Bennington soils generally are in nearly level areas where surface runoff is slow and the water table is seasonally high for significant periods. These differences in drainage cause other differences in the soils. Mottles, for example, are nearer the surface in the Bennington soils than in the Alexandria or Cardington. Also, the Bennington soils are grayer than the Alexandria and Cardington soils because they have been saturated for longer periods.

The poorly drained or very poorly drained soils in this county are in nearly level or depressional areas where surface runoff is slow to ponded and where silty and clayey material accumulates. Because organic matter decomposes slowly in wet soils, the poorly drained soils have a thick, dark-colored surface layer. Soils of this kind are in the Pewamo, Millsdale, and Sloan series. The muck of the Willette soils has accumulated in swampy, depressional areas where the soil material is saturated most of the time.

Of the soils in the same series, steep soils are generally thinner than the more nearly level soils. This is because runoff is more rapid and erosion is greater on the steep soils. For example, Alexandria silt loam, 18 to 25 percent slopes, has thinner horizons and a thinner solum than Alexandria silt loam, 6 to 12 percent slopes. Also, Rarden silt loam, 25 to 40 percent slopes, is generally thinner to shale than Rarden silt loam, 2 to 6 percent slopes, moderately eroded.

Processes of Soil Formation

The factors of soil formation discussed previously largely control or influence the soil-forming processes of (1) additions, (2) losses, (3) transfers, and (4) alterations. Some of the processes promote differences within a soil; others retard or preclude differences.

Additions to soils include additions of organic matter to the surface, additions of bases in the organic matter and in ground water, erosional deposition, and the addition of bases contained in lime and fertilizer. The dark-colored surface layer of the Pewamo, Westland, and other soils is evidence of the addition of organic matter. All of the soils in the county have had at least a thin layer of organic accumulation, but in most places cultivation has largely destroyed this identity. Plant nutrients, to some degree, move in a cycle from soil to plants and then back to soil again in the form of litter or other organic materials. This occurs in all of the soils in the county. The Bonpas, Millsdale, and Westland soils are seasonally waterlogged and continually accumulate bases through additions from the ground water. In these soils additions of bases are generally greater than losses. The Genesee, Ross, Shoals, and Sloan soils periodically receive additions of soil material from floodwaters. Additions of lime and fertilizer to cultivated soils counteract, or may even exceed, normal losses of plant nutrients.

Soil losses occur as removal of bases by leaching, removal of plant nutrients by crops, and actual losses of soil material through erosion. One of the most significant losses in Delaware County involves the leaching of carbonates. Carbonates have been removed to a depth of 25 to 30 inches in the Morley, Blount, Alexandria, Cardington, and most other soils on uplands in the county. This is a considerable quantity because the original material was 5 to 35 percent calcium carbonate. The removal is slower in those materials that are higher in carbonate content. Other minerals present 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 the fairly bright reddish or brownish colors in the Rarden, Fox, and similar soils. The recurrent water table in Pewamo, Westland, and other soils causes a reduction of iron oxides and subsequent loss by leaching. This is responsible for the gray colors of these soils. The mottling observed in all except the well-drained soils is caused by reduction and resegregation of the iron oxides.

The most significant transfer in the soils of Delaware County is the transfer 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 surface in cracks or root channels. Clay coatings of this kind can be seen in the Ockley, Milton, Morley, and similar soils. Various sesquioxides are also transferred from the surface layer 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. In the most important transformation, silicate clay minerals are formed. Illite and vermiculite are two of the most common clays in the soils in Delaware County. Kaolinite clay is an indicator of fairly intense weathering and occurs only in minor amounts in most of the soils in the county.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us in understanding their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large tracts, such as countries and continents.

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 (*6*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature (*5*, *9*). In table 9, soil series of Delaware County are placed in the categories of the current system and in the great soil groups of the older system.

Some of the soils in this county do not fit in a series that has been recognized in the classification system, but

297-845—69——5

Table 9.—*Soil series classified according to the current system of classification* [1] *and the 1938 system*

Series	Family	Subgroup	Order	Great soil group in the 1938 system
Alexandria	Fine, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Algiers	Fine-loamy, mixed, nonacid, mesic.	Aeric Fluventic Haplaquepts	Inceptisols	Alluvial soils.
Bennington	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils.
Blount	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils.
Bonpas [2]	Fine-silty, mixed, noncalcareous, mesic.	Typic Argiaquolls	Mollisols	Humic Gley soils.
Cardington	Fine, illitic, mesic	Aquic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Casco	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Colyer	Clayey-skeletal mixed, mesic	Lithic Dystrochrepts	Inceptisols	Lithosols.
Condit	Fine, illitic, misic	Typic Ochraqualfs	Alfisols	Low-Humic Gley soils.
Eel	Fine-loamy, mixed, mesic	Aquic fluventic Eutrochrepts	Inceptisols	Alluvial soils.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Genesee	Fine-loamy, mixed, mesic	Fluventic Eutrochrepts	Inceptisols	Alluvial soils.
Genesee (shallow variant).	Fine-loamy, mixed, mesic	Lithic Fluventic Eutrochrepts	Inceptisols	Alluvial soils.
Loudonville	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Loudonville (shallow variant).	Fine-loamy, mixed, mesic	Lithic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
McGary	Fine, mixed, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils.
Millsdale	Fine, mixed, noncalcareous, mesic.	Typic Argiaquols	Mollisols	Humic Gley soils.
Milton	Fine, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Morley	Fine, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Ockley	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Pewamo	Fine, mixed, noncalcareous, mesic.	Typic Argiaquolls	Mollisols	Humic Gley soils.
Randolph	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils.
Rarden	Clayey, mixed, mesic	Typic Hapludults	Ultisols	Red-Yellow Podzolic soils.
Ritchey	Loamy, illitic, mesic	Lithic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Ross	Fine-loamy, mixed mesic	Cumulic Hapludolls	Mollisols	Alluvial soils.
Shoals	Fine-loamy, mixed, nonacid, mesic.	Aeric Fluventic Haplaquepts	Inceptisols	Alluvial soils.
Sleeth	Fine-silty, mixed, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils.
Sloan	Fine-loamy, mixed, noncalcareous, mesic.	Fluventic Haplaquolls	Mollisols	Humic Gley soils.
Thackery	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Westland	Fine-loamy, noncalcareous, mixed, mesic.	Typic Argiaquolls	Mollisols	Humic Gley soils.
Willette	(3)	(3)	Histosols	Bog soils.

[1] Placement of some series in the current system of classification, particularly in families and subgroups, may change as more precise information becomes available.

[2] Recent changes in classification place the Bonpas series on the inactive list. Soils that have been placed in the Bonpas series in Delaware County will be placed in the Patton series in later surveys.

[3] Criteria has not been established for the classification of the Willette and other organic soils.

recognition of a separate series would not serve a useful purpose. Such soils are named for the series they strongly resemble because they differ from those series in ways too small to be of consequence in interpreting their usefulness or behavior. Soil scientists designate such soils as taxadjuncts to the series for which they are named. In this survey, soils named in the Algiers, Colyer, Eel, Genesee, Morley, Rarden, Ritchey, Sleeth, and Thackery series are taxadjuncts to those series.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. These properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. Most of the classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions are Entisols and Histosols, which occur in many different climates. Five of the soil orders are represented in Delaware County. They are Inceptisols, Mollisols, Alfisols, Ultisols, and Histosols.

Inceptisols are mineral soils in which horizons have started to develop but do not have an accumulation of illuvial clay.

Mollisols are mineral soils that have a dark-colored surface layer 10 inches or more thick and a base saturation of more than 50 percent.

Alfisols are mineral soils that have horizons of clay accumulation and a base saturation of more than 35 percent.

Ultisols are mineral soils that have horizons of clay accumulation and a base saturation of less than 35 percent.

The order Histosols has not been completely defined, but in Delaware County Willette muck is a Histosol.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that produce classes having the greatest genetic similarity. The soil properties used to separate suborders are mainly those that indicate the presence or absence of a seasonal high water table or other differences resulting from the climate or vegetation.

GREAT GROUP: Suborders are separated into groups according to the presence or absence of genetic horizons and the arrangements of these horizons. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans that interfere with the growth of roots or the movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central, or typic, segment of a group, and others, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is *Typic Hapludalfs.*

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils where used for engineering. Among the properties considered are texture, reaction, soil temperature, mineralogy, permeability, thickness of horizons, and consistence.

Laboratory Data

The physical and chemical analysis reported in table 10 were made of selected soils in Delaware County by the Ohio Agricultural Research and Development Center, Ohio State University. Detailed descriptions of the soils sampled, including locations of the profiles described, are given in alphabetical order in the section "Descriptions of the Soils."

In addition to the data given in table 10, other physical and chemical data are available for soils in the following series: Bennington, Cardington, Blount, Morley, Sleeth, Westland, Algiers, Fox, Thackery, Eel, Loudonville, Rarden, and Shoals. These data are on file at the Soils Department, Ohio State University; the Ohio Department of Natural Resources, Division of Lands and Soils; or the State Office, Soil Conservation Service, Columbus, Ohio.

General Nature of the County

This section provides general information about Delaware County. It discusses climate, geology, agriculture, and other subjects of general interest. The figures for population and the statistics on agriculture are from reports of the U.S. Bureau of the Census.

Delaware County was formed from a part of the Northwest Territory. It is centrally located in the State and lies north of Columbus, the State capital, in Franklin County. Settlement began early in 1801 in the area that is now Liberty Township. Most of the early settlers came from New York and Massachusetts and from Wales. Delaware, the county seat, was established in 1808.

The population of Delaware County was 2,000 in 1810 and 30,298 in 1950. In 1960, the population of the county was 36,107, and that of Delaware, the county seat, was 13,282.

There are no known deposits of coal, gas, or oil in Delaware County, and its most valuable natural resources are soil and water. A number of mineral and sulfur springs are scattered over the county. Minerals are quarried from different bedrock formations and used for roads, brick, drainage tile, and lime for agriculture uses.

In Delaware County, Federal, State, and county roads provide a complete network of highways. Interstate Highway No. 71 crosses the county from north to south. The county is served by three railroad lines that provide good shipping facilities. The municipal airport, located about 3 miles southwest of the city of Delaware, provides runways for small private planes.

TABLE 10.—*Physical and chemical*

[Analyses made by Ohio Agricultural Research and

Soil type, characterization number, and location	Horizon	Depth from surface	Particle size distribution: Very coarse sand (2 to 1 mm.)	Coarse sand (1 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.1 mm.)	Very fine sand (0.1 to 0.05 mm.)	Total sand (2.0 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (less than 0.002 mm.)	Fine clay (less than 0.0002 mm.)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Blount silt loam; DL–25: Scioto Township; 3¼ miles north-northwest of Ostrander.	Ap	0–8	1. 9	1. 5	1. 9	5. 3	5. 9	16. 5	62. 2	21. 3	3. 9
	B1	8–11	. 4	1. 1	. 9	5. 5	5. 5	13. 4	47. 2	39. 4	13. 0
	B21t	11–16	. 5	1. 4	1. 0	6. 1	5. 9	14. 9	37. 0	48. 1	19. 8
	B22t	16–20	1. 1	1. 8	1. 1	6. 5	6. 1	16. 6	37. 2	46. 2	18. 9
	B23t	20–24	1. 5	2. 7	1. 4	7. 0	6. 1	18. 7	36. 2	45. 1	17. 4
	B3–C1	24–29	1. 8	3. 5	1. 7	8. 7	8. 2	23. 9	39. 1	37. 0	13. 0
	C1	29–35	1. 9	2. 9	1. 5	8. 2	8. 7	23. 2	43. 8	33. 0	9. 5
	C2	35–44	1. 7	2. 6	1. 3	8. 4	10. 0	24. 0	43. 4	32. 6	8. 8
	C3	44–52	2. 7	3. 4	1. 6	8. 1	7. 9	23. 7	45. 0	31. 3	8. 8
	C4	52–60	2. 2	3. 5	1. 5	8. 0	8. 1	23. 3	45. 1	31. 6	8. 6
Cardington silt loam; DL–28: Porter Township; 2 miles northeast of East Liberty.	Ap	0–7	. 6	2. 1	2. 6	5. 8	7. 9	19. 0	62. 4	18. 6	4. 4
	B1	7–12	1. 0	2. 3	2. 0	4. 7	5. 9	15. 9	52. 6	31. 5	9. 3
	B21t	12–16	1. 6	3. 3	2. 7	5. 0	5. 8	18. 4	39. 6	42. 0	15. 2
	B22t	16–21	1. 3	3. 4	2. 9	6. 2	6. 8	20. 6	37. 4	42. 0	16. 2
	B23t	21–29	1. 7	3. 6	3. 0	6. 3	7. 1	21. 7	36. 5	41. 8	16. 8
	B3t	29–31	3. 3	4. 4	3. 8	8. 1	7. 0	26. 6	39. 1	34. 3	12. 6
	C1	31–36	2. 4	4. 8	4. 3	8. 1	7. 8	27. 4	41. 2	31. 4	10. 4
	C2	36–41	3. 4	5. 5	4. 7	9. 0	8. 4	31. 0	41. 2	27. 8	9. 0
	C2	41–46	3. 5	5. 9	4. 7	9. 1	8. 4	31. 6	40. 6	27. 8	8. 1
	C3	46–53	3. 5	5. 9	4. 7	8. 9	8. 0	31. 0	41. 7	27. 3	8. 5
Morley silt loam; DL–24: Troy Township; 3 miles northwest of town of Delaware.	Ap	0–7	. 6	1. 9	2. 7	6. 0	7. 2	18. 4	60. 8	20. 8	5. 2
	B1	7–11	. 9	1. 6	2. 2	5. 1	6. 2	16. 0	49. 9	34. 1	10. 2
	B21t	11–16	. 7	1. 6	2. 7	6. 2	5. 3	16. 5	37. 1	46. 4	21. 0
	B22t	16–21	. 7	1. 4	2. 2	5. 7	8. 1	18. 1	35. 9	46. 0	18. 2
	B3–C1	21–28	1. 3	2. 2	1. 3	7. 4	9. 0	21. 2	42. 6	36. 2	12. 0
	C1	28–34	2. 5	1. 4	2. 9	7. 0	10. 0	23. 8	44. 9	31. 3	9. 3
	C2	34–40	2. 0	2. 4	1. 5	8. 1	9. 6	23. 6	47. 0	29. 4	8. 0
	C3	40–46	1. 6	3. 0	3. 7	6. 9	9. 6	23. 8	46. 4	29. 8	7. 5
	C4	46–54	1. 4	2. 7	1. 6	8. 3	9. 8	23. 8	46. 2	30. 0	8. 2
	C5	54–60	1. 3	2. 9	1. 5	7. 5	8. 9	22. 1	47. 3	30. 6	9. 0
Pewamo silty clay loam; DL–41: Trenton Township; about 7 miles southeast of Sunbury.	Ap	0–6½	. 6	1. 5	1. 7	4. 5	4. 9	13. 2	58. 1	28. 7	10. 3
	Blg	6½–13½	. 3	1. 0	1. 4	3. 9	4. 4	11. 0	58. 4	30. 6	11. 3
	B21tg	13½–19½	. 9	1. 6	1. 4	3. 5	3. 7	11. 1	55. 4	33. 5	10. 2
	B21tg	19½–26½	. 4	1. 0	1. 0	2. 8	3. 4	8. 6	54. 7	36. 7	14. 3
	B22tg	26½–33½	1. 1	1. 3	1. 0	2. 5	2. 7	8. 6	49. 5	41. 9	19. 4
	B22tg	33½–40½	1. 0	1. 8	1. 7	3. 8	3. 5	11. 8	48. 9	39. 3	18. 4
	B3	40½–48½	. 5	1. 3	1. 2	3. 3	3. 5	9. 8	53. 7	36. 5	14. 9
	B3	48½–56	1. 0	2. 3	1. 9	4. 6	4. 8	14. 6	48. 8	36. 6	13. 2
	B3	56–65	. 9	2. 3	2. 2	4. 8	5. 4	15. 6	48. 7	35. 7	11. 8
	B3	65–74	. 8	1. 8	1. 7	4. 8	5. 3	14. 4	51. 4	34. 2	13. 2
	C	74–95	4. 1	5. 6	3. 9	9. 2	9. 4	32. 2	44. 3	23. 5	7. 1

data for selected soils

Development Center, Ohio State University]

Textural class	Reaction	Organic matter	CaCo3 equivalent	Exchangeable cations (meq. per 100 grams of soil)						Base saturation
				Hydrogen	Calcium	Magnesium	Potassium	Sum of exchangeable cations	Total bases	
	pH	*Percent*	*Percent*							*Percent*
Silt loam	6. 7	3. 2		4. 0	11. 8	2. 0	0. 3	18. 1	14. 1	78
Silty clay loam	4. 8	1. 0		12. 3	7. 2	3. 2	. 3	23. 0	10. 7	47
Clay	4. 5	1. 0		15. 7	6. 2	5. 1	. 3	27. 3	11. 6	42
Clay	5. 1	1. 0		9. 6	7. 8	7. 4	. 3	25. 1	15. 5	62
Clay	6. 6	. 7		4. 4	10. 3	9. 4	. 3	24. 4	20. 0	82
Clay loam	7. 6		10. 2							
Clay loam	7. 8		29. 5							
Clay loam	7. 8		24. 4							
Clay loam	7. 9		27. 4							
Clay loam	7. 9		27. 6							
Silt loam	5. 0	2. 1		8. 7	2. 9	. 9	. 2	12. 7	4. 0	31
Silty clay loam	4. 7	. 6		11. 6	2. 2	1. 2	. 1	15. 1	3. 5	23
Clay	4. 7	. 4		12. 8	3. 7	1. 9	. 2	18. 6	5. 8	31
Clay	5. 0			10. 2	6. 2	3. 3	. 2	19. 9	9. 7	49
Clay	6. 5			4. 1	10. 1	4. 6	. 2	19. 0	4. 9	78
Clay loam	7. 8		9. 7							
Clay loam	8. 1		16. 0							
Clay loam	8. 1		20. 9							
Clay loam	8. 2		20. 6							
Clay loam	8. 2		21. 5							
Silt loam	5. 8	2. 5		6. 9	7. 1	1. 4	. 2	15. 6	8. 7	56
Silty clay loam	5. 9	. 8		6. 6	9. 4	2. 7	. 2	18. 9	12. 3	65
Clay	5. 1	. 7		10. 3	10. 1	4. 0	. 3	24. 7	14. 4	58
Clay	6. 4	. 8		6. 0	12. 4	5. 5	. 3	24. 2	18. 2	75
Clay loam	7. 7		16. 2							
Clay loam	7. 8		24. 5							
Clay loam	7. 8		27. 3							
Clay loam	7. 8		26. 5							
Clay loam	7. 9		27. 4							
Clay loam	7. 9		27. 4							
Silty clay loam	5. 2	4. 4		14. 2	9. 3	3. 0	. 3	26. 8	12. 6	47
Silty clay loam	5. 4	3. 7		11. 9	10. 3	4. 0	. 3	26. 5	14. 6	55
Silty clay loam	6. 0	2. 2		7. 3	11. 0	5. 3	. 2	23. 8	16. 5	69
Silty clay loam	6. 1	. 7		5. 3	11. 2	6. 0	. 3	22. 8	17. 5	77
Silty clay	6. 5			5. 4	12. 8	7. 3	. 4	25. 9	20. 5	79
Silty clay loam	6. 6			4. 4	11. 6	6. 7	. 4	23. 1	18. 7	81
Silty clay loam	6. 4			4. 1	10. 3	5. 7	. 3	20. 4	16. 3	80
Silty clay loam	6. 8			3. 4	9. 3	4. 5	. 3	17. 5	14. 1	81
Silty clay loam	7. 0			3. 0	9. 5	4. 2	. 3	17. 0	14. 0	82
Silty clay loam	7. 0			3. 1	10. 0	4. 5	. 3	17. 9	14. 8	83
Loam	7. 9		18. 1							

Climate [6]

The climate of Delaware County is continental, and rainfall is fairly well distributed throughout the year. Data on temperature and precipitation for the county are given in table 11. The probabilities of the last freezing temperatures in spring and the first in fall are given in table 12.

The data given in tables 11 and 12 are from the records kept at the city of Delaware, which is at an elevation of 840 feet. These figures apply to the county as a whole, except that in valley bottoms the average temperature generally is a few tenths of a degree higher than that in other parts of the county. The mean annual precipitation is 36.76 inches, but variations are considerable from year to year.

[6] By L. T. Pierce, State climatologist, U.S. Weather Bureau, Columbus, Ohio.

Table 11 gives monthly readings in temperature that may be expected to occur in typical years rather than the highest and lowest readings that have been recorded. Also, the amount of precipitation under "One year in 10 will have—" are monthly totals for the lowest and highest rainfall likely to occur during once in 10 years, or a probability of 10 percent.

Table 12 shows the probability of freezing temperatures on or after given dates in spring and on or before given dates in fall. The 36° temperature is included in the table because light frost can occur when the temperature of the air is several degrees above freezing. In contrast, some kinds of plants are not injured unless the temperature falls 4 or more degrees below freezing. In Delaware County the growing season, or that period normally free from freezing temperatures, is 159 days.

Table 11.—*Temperature and precipitation for Delaware County*

[All data from records kept at the city of Delaware]

Month	Temperature					Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Average	Two years in 10 will have at least 4 days with [2]— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with [2]— Minimum temperature equal to or lower than—	Average monthly total [1]	One year in 10 will have [3]— Less than—	One year in 10 will have [3]— More than—	Average number of days with snow on ground [2]	Average depth of snow on days with snow on ground [2]
	° F.	° F.	° F.	° F.	° F.	Inches	Inches	Inches		Inches
January	36. 7	19. 9	28. 3	55. 1	2. 3	2. 92	0. 81	5. 62	18	1. 5
February	39. 8	21. 5	30. 6	57. 7	4. 8	2. 39	. 96	4. 12	15	1. 3
March	49. 7	28. 8	39. 2	68. 6	12. 6	3. 60	1. 39	6. 27	9	1. 1
April	62. 4	38. 4	50. 4	80. 3	24. 5	3. 73	1. 75	6. 04	1	(4)
May	73. 6	48. 6	61. 1	86. 4	35. 0	3. 44	1. 61	5. 60	0	0
June	82. 4	57. 7	70. 0	92. 5	46. 1	4. 49	1. 73	7. 84	0	0
July	85. 9	66. 7	73. 4	93. 1	50. 9	3. 67	2. 08	5. 47	0	0
August	84. 4	59. 4	71. 9	93. 0	49. 3	3. 03	1. 20	5. 24	0	0
September	77. 9	52. 2	65. 0	89. 7	38. 6	2. 69	1. 09	4. 61	0	0
October	66. 7	41. 5	54. 1	81. 2	28. 7	2. 10	. 46	4. 43	(5)	(4)
November	51. 1	31. 4	41. 2	67. 3	17. 9	2. 40	1. 01	4. 04	4	1. 1
December	38. 9	22. 6	30. 7	58. 0	3. 7	2. 30	. 99	3. 93	15	2. 2
Year	62. 5	40. 8	51. 4			36. 76	29. 76	44. 23	62	1. 5

[1] Based on 30-year record, through 1965.
[2] Based on 20-year record, through 1960.
[3] Based on 30-year record, through 1965.
[4] Trace.
[5] Less than 1 day.

Table 12.—*Probabilities of the last freezing temperatures in spring and the first in fall*

[Data from records kept at the city of Delaware]

Probability	Dates for given probability at temperatures of—					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
Spring:						
1 year in 10 later than	March 27	April 9	April 17	April 28	May 1	May 24
2 years in 10 later than	March 22	April 3	April 12	April 24	April 21	May 20
5 years in 10 later than	March 10	March 21	March 31	April 16	April 15	May 11
Fall:						
1 year in 10 earlier than	November 2	October 29	October 21	October 9	September 23	September 14
2 years in 10 earlier than	November 6	November 3	October 26	October 13	September 27	September 18
5 years in 10 earlier than	November 18	November 15	November 4	October 24	October 7	September 26

The climate of this county, as of any area, is a major factor in determining the temperature and moisture characteristics of the soils and, therefore, their productivity. Rainfall averages 17.32 inches in the growing season (May–September). Although precipitation is low in winter, this is the recharge season when soil-moisture reserves are replenished because not much of the moisture is being used. Rainfall is generally sufficient to maintain a high level of soil moisture until late in June. If spring is very dry, however, a shortage of moisture can develop by the middle of June. In spring, chances are more than 50 percent that at least 0.60 inch of rain will fall each week and are 30 percent that the rate will be 1 inch per week. The rate of 0.60 inch per week almost meets the needs of meadows and small grains, but during July and August there is a shortage of moisture; ordinarily all except 10 to 20 percent of the available moisture is exhausted. Summer must be unusually wet if an available moisture supply of more than 50 percent is to be maintained.

The temperature of the soils is important to farmers, especially in spring. Soil frozen to a depth of 2 feet or more early in March generally thaws in only a week to 10 days of mild weather. Thereafter, the rise in temperature of the surface soil lags not more than 2 days behind the temperature of the air. Hence, the effects of an unusually cold winter do not carry over into the spring. In Delaware County, the soil temperature is generally favorable for the germination of corn by the first week in May. Soils generally are warmest on the slopes facing south and west and are coldest on slopes facing north. Soils on bottom lands tend to be a few degrees warmer in spring than soils on uplands, where they are exposed to stronger winds.

In an average year, there are 101 clear days, 118 partly cloudy days, and 146 cloudy days in Delaware County. Summer, the season of most sunshine, has 70 percent of its days sunny; cloudy days are most numerous in winter. Relative humidity averages about 50 percent on summer afternoons when the air normally is driest, though it may fall below 30 percent on some days. Relative humidity is highest early in the morning, when the average for the year is between 76 and 83 percent. Tornadoes are not unknown in this county, but they are less frequent and cause less damage than those in the States farther west. Most of the tornadoes in Ohio are poorly developed and are in short, narrow paths.

Geology

Delaware County was invaded by a succession of glaciers of both the Illinoian and the Wisconsin ages. The drifts laid down by the Illinoian glaciers, however, were completely swept away by the advance of the Wisconsin glaciers. Today only drifts deposited by the Wisconsin glaciers can be seen in the county. The last glaciation occurred about 23,000 years ago and covered all of Delaware County.

The glacial drift, or till, that covers the western half of the county contains much limestone and dolomite and is highly calcareous. The drift that covers the eastern half of the county contains large amounts of sandstone and shale and smaller amounts of limestone and dolomite and is only moderately or slightly calcareous.

As the glacial ice melted, the meltwater carried and deposited outwash material. In contrast to the glacial till, the outwash material is sorted and stratified. It forms plains and, near places where glacial lakes used to be, deltas. Glacial outwash is also in valley trains made up of material deposited along the edges of streams that flowed from the face of the glaciers.

Near moraines the outwash material is poorly sorted because the water did not flow rapidly enough to sort the material properly. This outwash material is in the form of eskers and kames.

Eskers about 20 feet high and about 150 feet wide at the base are a prominent feature of the landscape in the northern and central parts of Radnor Township. These formations consist of soils that developed on ridges of gravel and sand (*4*). They originated as sand and gravel deposited by streams flowing from the melted ice (*11*). Soils of the Casco and Fox series are dominant on eskers in this county.

Kames are prominent, moundlike hills formed from sand and gravel that were deposited in openings in the ice or on the ice. In Delaware County, kames merge with the northern slopes of the Powell Moraine in the central part of Radnor Township and on the uplands bordering the Olentangy River. They also occur in Trenton Township, but here they do not connect with the Powell Moraine.

The bedrock in Delaware County is almost completely concealed beneath the glacial till. It can be seen only where streams have cut through the till. The bedrock is much older than the till and can be easily distinguished from it. This bedrock is limestone, shale, and some sandstone. It formed from marine sediments about a billion years ago, as is indicated by the presence of marine fossils.

Agriculture

According to the United States Census of Agriculture, Delaware County had 1,286 farms totaling 206,861 acres in 1964. Cropland amounted to about 124,583 acres. The land in farms decreased from 83.6 percent of the total land area in 1959 to 73.5 percent in 1964. This decrease of land in farms has continued in recent years because of community development, more recreational facilities, and highway construction. The average size of farms, however, increased from 136.3 acres in 1959 to 160.9 acres in 1964. This increase has been caused by economic conditions and the increased use of modern farming equipment.

Of the 1,286 farms in the county in 1964, 792 were operated by owners, 345 by part owners, and the rest by managers and tenants. Off-farm employment is common, and 620 farmers reported that they had worked off their farms.

Livestock raising and the production of general field crops are the most important types of farming in Delaware County. In 1964, livestock and livestock products accounted for about 56 percent of the value of all farm products sold in Delaware County, and field crops, other than vegetables, fruits, and nuts, accounted for about 42 percent.

In 1964, the principal kinds of livestock on farms in Delaware County were as follows:

	Number
Cattle and calves	24, 955
Milk cows	6, 276
Hogs and pigs	28, 216
Sheep and lambs	17, 288
Chickens (4 months old and over)	40, 806
Turkeys	15, 482

The average acre yields of corn, small grain, soybeans, and hay have increased because of improved tillage, fertilization, and drainage practices and the use of better seed, especially of hybrid corn.

Acreages of the principal crops harvested in 1964 were as follows:

	Acres
Corn (all purposes)	44,447
Wheat	16,920
Oats	6,889
Barley (for grain)	39
Rye (for grain)	133
Soybeans (all purposes)	32,161
Hay crops (excluding soybeans)	21,707
Red clover seed	1,691
Timothy seed	446
Popcorn	352

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Glossary

Alluvial soils. Soils developing from soil material (alluvium) transported by water and recently deposited.

Available water capacity. The capacity of a soil to hold water in a form available to plants. The difference between the amount of water held in a soil at field capacity and the amount in the same soil at the permanent wilting point. Commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil that contains enough lime or calcum carbonate (often with magnesium carbonate) to effervesce (fizz) when treated with dilute hydrochloric acid. It is alkaline in reaction because calcium carbonate is present.

Chroma. The relative purity or strength of the spectral color; increases with decreasing grayness.

Clay. As a soil separate, the small mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay loam. Soil material that is 27 to 40 percent clay and 20 to 45 percent sand.

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; will 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, soil. The rapidity and extent of the removal of water from the soil, in relation to additions, especially by surface runoff, or by flow through the soil to underground spaces, or by a combination of both processes.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Eskers. A long narrow ridge or mound of sand, gravel, and boulders deposited by a stream flowing on, within, or beneath a stagnant glacier.

Glacial drift. Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial outwash. Cross-bedded gravel, sand, and silt deposited by melting water as it flows from glacial ice.

Glacial till. Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Granule. A single mass, or cluster, of many individual soil particles.

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 (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. The 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.

Kame (geology). A short ridge, hill, or mound of stratified glacial drift deposited by glacial meltwater.

Loam. Soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Nutrients, plant. Any element that is taken in by a plant, is essential to its growth, and used by the plant in producing food and tissue. Important plant nutrients obtained from the soil are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps others. Those obtained from the air are carbon, hydrogen , and oxygen.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. 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.*

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words the degree of acidity or alkalinity is expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 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

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of 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.

Silt loam. Soil material that is 50 percent or more silt and 12 to 27 percent clay or is 50 to 80 percent silt and less than 12 percent clay.

Silty clay loam. Soil material that is 27 to 40 percent clay and less than 20 percent sand.

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.

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. The lower part of the soil profile below plow depth. Technically, the B horizon.

Substratum. Any layer beneath the solum, or true soil; the C or R horizon.

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 as follows: 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.

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.

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