

SOIL SURVEY

Preble 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

Issued June 1969

Major fieldwork for this soil survey was done in the period 1957-61. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1960. This survey was made cooperatively by the Soil Conservation Service and the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Preble Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Preble County, Ohio, 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 tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of Preble 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.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suit-

ability or limitations for a particular use. 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 interpretative grouping.

Land use planners, county commissioners, and others interested in broad land use planning will find information about use of the soils for selected nonagricultural purposes in the section "Land Use Planning: Soils and Rural-Fringe Development."

Engineers and builders will find under "Engineering Uses of the Soils" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

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

Students, teachers, and others will find information about soils and their management in various parts of the text, depending on their particular interests.

Newcomers in Preble 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" which gives additional information about the county.

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SOIL SURVEY OF PREBLE COUNTY, OHIO

BY NORBERT K. LERCH, PAUL E. DAVIS, LAWRENCE A. TORNES, ERNEST N. HAYHURST, AND NILES A. McLODA, SOIL CONSERVATION SERVICE

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

PREBLE COUNTY is in the southwestern part of Ohio (fig. 1). It is bounded on the west by Indiana, on the south by Butler County, on the east by Montgomery County, and on the north by Darke County. It occupies approximately 273,280 acres, or 427 square miles. The county is rectangular in shape and consists of 12 townships.

The population of the county in 1960 was 32,498. Eaton, the county seat and largest community, is near the center of the county. It had a population of 5,034 in 1960. Other communities and their population in 1960 were: New Paris, 1,679; West Alexandria, 913; Lewisburg, 1,415; Camden, 1,308; Gratis, 586; West Manchester, 460; and Eldorado, 449.

Large areas of deep, fertile, level land have made Preble County well suited to agriculture. Corn, wheat, oats, soybeans, and hay are the principal crops. Grain crops are used mainly as feed for livestock. Most of the farm income

is derived from the sale of livestock and livestock products.

Preble County is part of the dissected glacial till plain of the Wisconsin age (3).¹ The covering of glacial drift has greatly subdued the former relief. For the most part, the topography is nearly level to gently sloping. In some places it is irregular, however. These areas occur where the till deposits are thin over the underlying bedrock of limestone, dolomite, or shale (11). The various moraines (fig. 2) and kamelike deposits are also irregular.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Preble 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 into the parent 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. Miami and Brookston, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and

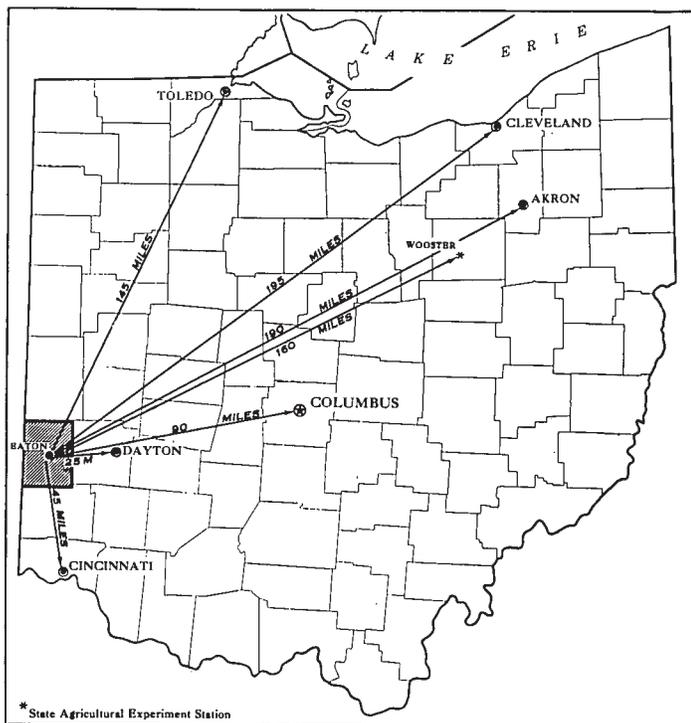


Figure 1.—Location of Preble County in Ohio.

¹ Italicized numbers in parentheses refer to Literature Cited, page 99.

SOIL SURVEY
DARKE COUNTY

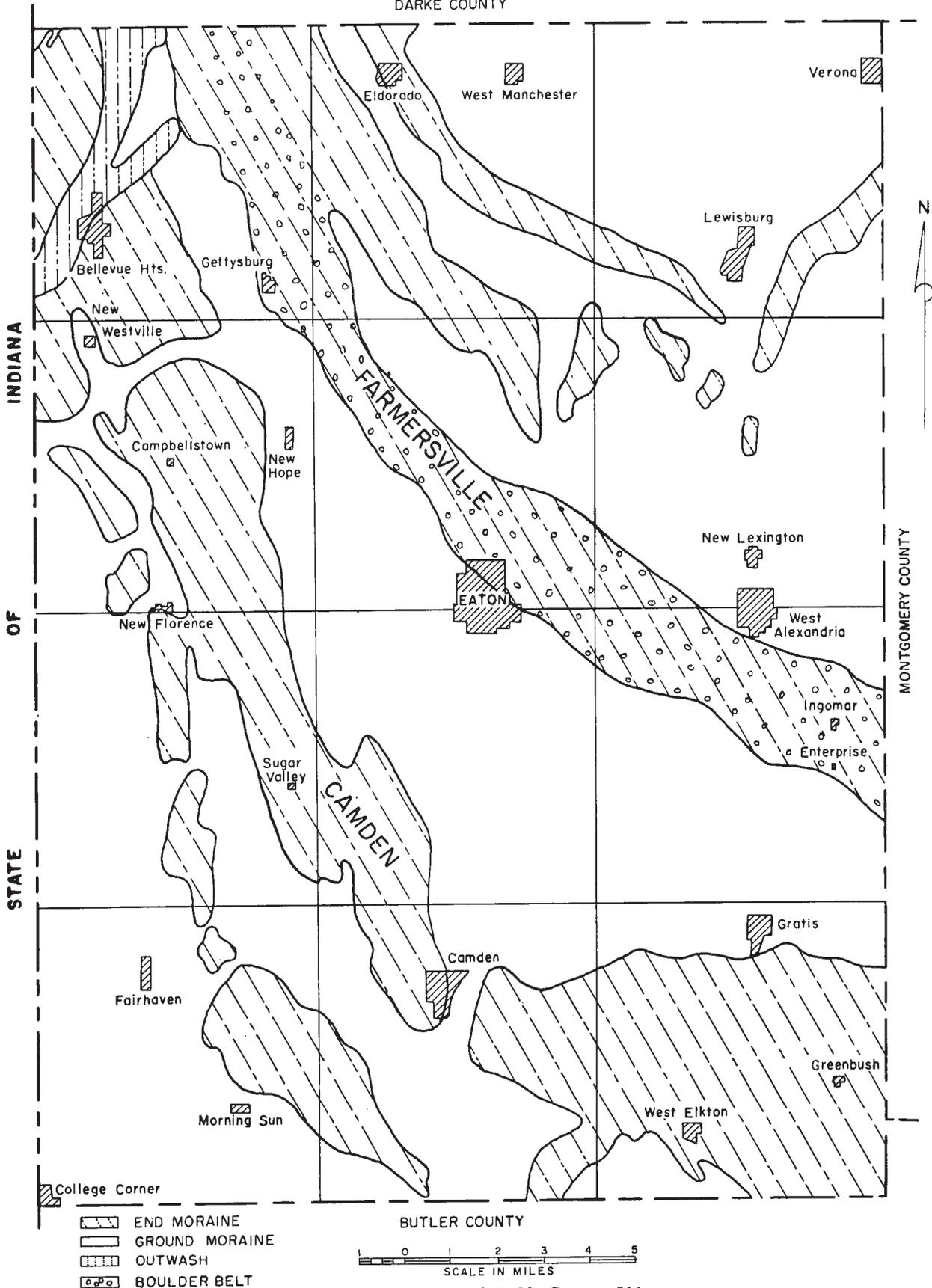


Figure 2.—Moraines of Preble County, Ohio.

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. Brookston silt loam and Brookston silty clay loam are two soil types in the Brookston series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size 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, Milton silt loam, 2 to 6 percent slopes, is one of several phases of Milton silt loam, a soil type that ranges from nearly level to sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning 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 kind 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 delineating 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, Miami-Celina silt loams, 2 to 6 percent slopes.

Another kind of mapping unit is the undifferentiated soil group. The undifferentiated soil group consists of two or more soils not separated on the map, because differences among them are small, their practical value is limited, or they are too difficult to reach. In Preble County an example of an undifferentiated soil group is Casco, Rodman, and Fox soils, 18 to 25 percent slopes, moderately eroded. In that group, the soils are so steep that mapping them separately is not significant to their use and management.

Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be classified by soil series. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Gullied land, steep, or Riverwash, and are called land types rather than soils.

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 all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used. 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 then 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 Preble 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, and other characteristics that affect management.

The 11 soil associations in Preble County are described in the following paragraphs.

1. Miami-Fox-Hennepin Association

Steep, well-drained soils that are mostly shallow over calcareous till or calcareous sand and gravel

Steep valley walls and hummocky, kamelike glacial moraine topography characterize this association. Although most of the soils are shallow to calcareous till, they range from shallow to deep. The largest areas of this association are along the east and west valley walls of Seven Mile and Faint Creeks in the southern part of the county. Sizable areas occur around Acton Lake and along valley walls of Four Mile Creek in the southwestern part. This association comprises about 4 percent of the county.

The Miami, Fox, and Hennepin soils occupy about 75 percent of the association. The Ritchey and Channahon soils, which are shallow to limestone bedrock, occupy about 10 percent. The steep, shallow Fairmount soils occupy about 8 percent, and minor soils, such as the Casco and Rodman, about 7 percent.

Steep slopes, shallowness, and the hazard of erosion are major limitations of the soils of this association. Consequently, most of the acreage is used for pasture or woodland.

2. Milton-Wynn Association

Well-drained soils that are mostly moderately deep over limestone

This association consists of soils that have developed in silt-mantled till or outwash of varying thickness. These soils are on uplands and terraces. The largest areas, in the southern part of the county, are dissected and have ridge and valley relief. One large area is on the limestone bedrock hill on which Lanier Township School is located. Another large area is in the southwestern corner of Somers Township. This association occupies about 1 percent of the county.

The Milton soils make up about 50 percent of this association. They are light colored and have developed mainly in till over bedrock. In a few areas along Twin Creek, however, they have developed in a thin layer of outwash material over bedrock. The Wynn soils occupy about 28 percent of the association. They are similar to the Milton soils but have developed in a deeper mantle of silt that is from 18 to 36 inches thick.

Of lesser extent in this association are the Randolph and Millsdale soils. The Randolph soils are similar to the Milton soils but are somewhat poorly drained. The Millsdale soils are dark colored and very poorly drained.

A large part of this association is farmed to general crops common to the county. Erosion is the main hazard, and soil and water conservation practices are needed in all areas.

3. Ragsdale-Reesville-Birkbeck Association

Very poorly drained, somewhat poorly drained, and moderately well drained, deep soils on uplands covered by a thick mantle of silty material

The soils of this association have developed in neutral or calcareous wind-deposited material that is more than 3 feet thick. They are in a single fairly level area in the west-central part of the county, an area known locally as the Boston Plains. This association occupies about 2 percent of the county.

The Ragsdale soils are very poorly drained. They occupy about 50 percent of the association.

The Birkbeck soils are moderately well drained, and the Reesville soils are somewhat poorly drained. The Reesville soils have some grayish-brown to gray mottling in the subsoil. The Reesville soils occupy 25 percent of the association. The Birkbeck soils occupy 20 percent.

Areas of Fincastle and Xenia soils occur as small "islands," or slightly higher, irregularly shaped areas, where the silt mantle is not so thick or where the till is closer to the surface.

The soils of this association are farmed intensively. The Ragsdale and Reesville soils, however, need artificial drainage. Cultivated Birkbeck soils that have long slopes will erode if they are not protected. Most of the soils of this association are nearly level, however, and for this reason erosion is not a serious hazard.

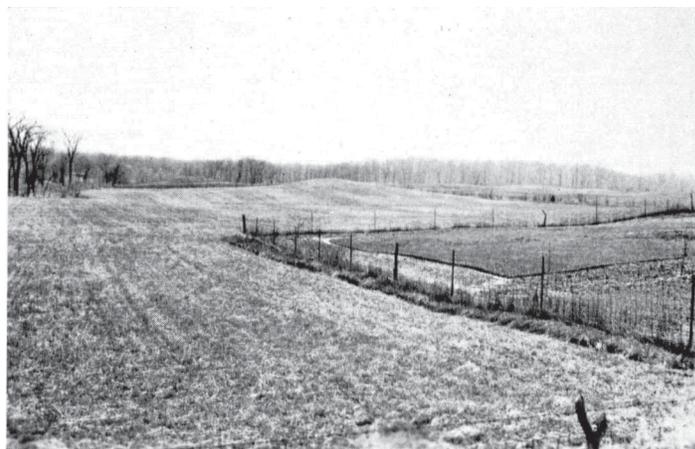


Figure 3.—Rolling and hummocky areas of Miami, Celina, and Kendallville soils on the crest of the Camden moraine in soil association 4.

4. Miami-Celina Association

Well drained and moderately well drained, deep soils on uplands covered by a thin mantle of silty material; underlain by calcareous till

This is the most extensive soil association in the county. The major soils have formed in silt-mantled till on nearly level to rolling areas of the till plains; on hummocky, kamelike areas of moraines (fig. 3); and on gently to strongly sloping areas on the sides of drainageways. This association occupies about 44 percent of the county.

The Miami soils are light colored and well drained. They formed mainly in loam-textured, limy glacial till, but in places as much as 18 inches of soil has formed in wind-deposited material over the till. In appreciably eroded areas, little or none of this wind-deposited material is left. The Miami soils occupy about 50 percent of this association and typically are on knolls, rolling topography, and strongly sloping areas.

The Celina soils are similar to the Miami soils, except that they are only moderately well drained. They comprise about 45 percent of the association and typically are nearly level and gently sloping.

Minor soils in the association are the Kendallville and Ockley.

Erosion is a major problem throughout the association, and conservation of soil and water is necessary in sloping areas. A small part of this association is in the boulder belt and has glacial boulders on the surface in numbers that interfere with cultivation.

Most of this association is farmed intensively. Strongly sloping areas are generally used for pasture or woodland.

5. Crosby-Brookston Association

Somewhat poorly drained and very poorly drained, deep soils on uplands covered by a thin mantle of silty material; underlain by calcareous till

Broad, nearly level to gently sloping soils on till plain topography are characteristic of this association. The areas are both large and small and are scattered from the west-

central part of the county east to the county line. This association comprises about 26 percent of the county.

The pattern of the major soils throughout the association is clearly discernible. The light-colored, somewhat poorly drained Crosby soils are on low knolls and are slightly higher than the dark-colored, very poorly drained Brookston soils.

The Crosby soils occupy about 50 percent of the association. Brookston soils occupy about 48 percent. The Odell and other minor soils occupy about 2 percent.

Wetness is a major problem, and practically all of the soils need tile or surface drains. In some areas the soils lack adequate outlets. In the boulder belt shown on the general soil map, boulders interfere with the use of the bouldery Crosby soils.

Most of this association has been drained and is farmed intensively. Undrained areas are used for woodland or wooded pasture. Every year, some of these undrained areas are cleared and drained and then cultivated.

6. Russell-Xenia Association

Well drained and moderately well drained, deep soils on uplands covered by a moderately thick mantle of silty material; underlain by calcareous till

This association occurs in uplands south and west of the Camden glacial moraine. Large areas of nearly level to strongly sloping soils are in Israel and Dixon Townships. In this part of the county, the soils have longer, more uniform slopes than elsewhere. This association occupies about 5 percent of the county.

The light-colored, well-drained Russell soils occupy about 50 percent of the association. Their surface layer and upper subsoil have developed in the loess mantle, and their lower subsoil has developed in till.

The Xenia soils are like the Russell soils, except that they are not quite so well drained and have mottled colors below a depth of about 1½ feet. The Xenia soils occupy about 40 percent of the association.

The Corwin and other minor soils occupy about 10 percent of the association.

Much of this association is cultivated intensively to crops commonly grown in the county. Erosion is the main problem because of the silty surface layer and the long slopes. The strongly sloping Russell soils are generally used for pasture or woods.

7. Fincastle-Brookston Association

Somewhat poorly drained and very poorly drained, deep soils on uplands covered by a moderately thick mantle of silty material; underlain by calcareous till

This association occupies scattered areas in the southwestern part of the county and some small areas in the west-central part. The largest areas are on a broad till plain in a tier of six sections north of College Corner and adjacent to the Indiana State line. Here, the nearly level soils lie between the main tributaries of Four Mile Creek. This association occupies about 3 percent of the county.

Together, the Fincastle and Brookston soils comprise a distinctive pattern on the landscape. The lighter colored Fincastle soils are on the large, irregularly shaped, slight

rises, and the Brookston soils are in depressions and at the heads of and in shallow waterways. The Fincastle soils make up about 48 percent of this association, and the Brookston soils, about 47 percent.

The Fincastle soils have a silt capping, 1½ to 3 feet thick. They are somewhat poorly drained and have considerable mottling of gray and brownish gray in the subsoil.

The Brookston soils are very poorly drained and have gray and yellow mottling in the subsoil. Depth to the underlying till is generally greater in the Brookston soils than in the Fincastle soils.

The Raub and other minor soils make up about 5 percent of this association.

Most of the soils of this association are cultivated intensively to crops common to the county, especially to corn. Both the Fincastle and Brookston soils need artificial drainage to remove excess water. Tile and surface drains are used, but some areas lack adequate outlets. Undrained areas are used for woodland or wooded pasture. Every year some of these areas are cleared and drained and then cultivated.

8. Fox-Ockley-Thackery Association

Well drained and moderately well drained, moderately deep and deep soils on outwash sand and gravel

This association consists of nearly level to strongly sloping soils on terraces and outwash plains. Sizable areas are on the west side of Twin Creek near West Alexandria. New Paris is near the center of another sizable area. Smaller areas occur along the larger streams. This association occupies about 4 percent of the county.

The Fox soils make up about 60 percent of this association. They are well drained and have formed in 2 to 3½ feet of silty or loamy material over stratified sand and gravel.

The Ockley soils occupy about 15 percent of the association, and the Thackery soils, about 10 percent. They have formed in 3½ to 5 feet of mostly silty material over stratified sand and gravel. The Ockley soils are well drained; the Thackery soils are moderately well drained.

The Tippecanoe and Warsaw soils are minor soils in the association.

A large part of this association is farmed intensively to the crops commonly grown in the county. The soils are well suited to irrigation. The Fox soils, however, tend to be droughty because of the limited depth to sand and gravel. The steeper Fox soils are used mostly for pasture. Erosion is a problem in sloping areas.

9. Ross-Medway-Landes Association

Well drained and moderately well drained soils on flood plains

This association consists of soils that have formed on first bottoms of streams in sediments derived from glacial uplands and outwash terraces. The areas are along all drainageways that are big enough to have flood plains. The largest areas are adjacent to Twin and Seven Mile Creeks. This association occupies about 6 percent of the county.

The Ross soils are dark colored and well drained and have formed in medium-textured sediments. They occupy about 65 percent of the association.

The Medway soils are similar to the Ross soils, but they are moderately well drained. They have mottled colors 1 foot to 2 feet below the plow layer. The Medway soils comprise about 20 percent of the association.

The Landes soils are similar to the Ross soils, but they are coarser textured. Typically, they have about 3 to 4 feet of moderately coarse textured material over gravel or rock rubble. Most areas are along small intermittent waterways. Larger areas occur next to the larger streams, where fast-flowing water has washed in rock rubble and then slower flowing water has deposited finer material on top of it. The Landes soils cover about 10 percent of the association.

The Ross and Medway soils in this association are farmed intensively to row crops, especially to corn. The Landes soils tend to be droughty because of limited depth to sand or gravel. Consequently, they are generally left in pasture or woods, although some areas are cultivated. The major soils are well suited to irrigation because they are nearly level and have excellent internal drainage. If not protected by levees, however, crops grown on all of these soils are susceptible to damage from overflow. Because flooding occurs late in winter or early in spring, these soils are not generally suitable for fall-sown small grains.

10. Westland-Sloan-Sleeth Association

Very poorly drained and somewhat poorly drained soils on terraces and flood plains

This association consists of soils that have formed in medium-textured to moderately fine textured materials. These soils are in all of the sizable stream valleys of the county. One of the largest areas occurs north of New Paris in the wide glacial outwash valleys of the East Fork of the Whitewater River and its tributaries. Another large area is north of Lewisburg in the upper reaches of Twin Creek and its tributary valleys. This association occupies about 3 percent of the county.

The Westland soils are dark colored and very poorly drained and have much dark-gray mottling in the subsoil. They have formed in outwash material that overlies stratified sand and gravel. They occupy about 55 percent of the association.

The Sloan soils are also dark colored and very poorly drained. They are on flood plains and have formed in alluvial sediments mainly from glaciated uplands. They occupy 30 percent of the association.

The Sleeth soils are similar to the Westland soils but have a light-colored surface layer and are somewhat poorly drained. They have gray mottling in the subsoil. They occupy about 7 percent of the association.

Minor soils in the association include the Shoals, Bonpas, and Crane.

A large part of this association is farmed intensively to crops common to the county, especially to corn. The soils need artificial drainage. Typically, their water table is close to the surface, at least during wet seasons. Obtaining outlets for tile drains is a problem in some areas. Crops grown on Sloan soils are subject to damage from

overflow. Since they are on sand and gravel terraces, the Westland and Sleeth soils are normally high enough to escape damage during all but the most severe floods.

11. Lewisburg-Pyrmont Association

Moderately well drained and somewhat poorly drained soils on uplands; underlain by calcareous till

This association consists of nearly level to sloping soils on till plains of the Wisconsin age. These soils are shallower to calcareous till than surrounding soils. This association occurs in two large areas about 9 miles apart in the northern part of the county. The largest area is just west of Eldorado in Monroe and Jefferson Townships. A somewhat smaller area is 2 miles southeast of Lewisburg in Twin and Harrison Townships. This association occupies about 2 percent of the county.

The Lewisburg soils are light colored, moderately well drained, and gently sloping to sloping. They have formed in calcareous till. They are shallow to till, normally less than 1½ feet. The Lewisburg soils occupy about 60 percent of this association.

The Pyrmont soils are light colored, somewhat poorly drained, and nearly level to gently sloping. They also have formed in calcareous till. Like the Lewisburg soils, they normally are underlain by till at a depth of less than 1½ feet. The Pyrmont soils occupy about 40 percent of this association.

A large part of this association is cultivated to crops common to the county. The underlying loam till is fairly compact, and this results in seasonal wetness and slow drying of the soils in spring. The Pyrmont soils need artificial drainage. Where they are gently sloping, erosion is a hazard. Moderately sloping Lewisburg soils need conservation practices that control loss of soil and water. Both soils are typically neutral in reaction throughout the subsoil. Some areas of Lewisburg soils are severely eroded, and calcareous loam till is exposed at the surface. These areas are generally used for pasture or are idle and abandoned for agriculture.

Use and Management of the Soils

This section contains discussions on use and management of the soils for agriculture, wood crops, wildlife, engineering, and rural-fringe development.

Capability Groups of Soils²

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 the limitations of the soils, the risk of damage when they are used for the ordinary field crops or sown pastures, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops that have their own special requirements. The soils are classified according to degree and kind of permanent limitations, but without consideration of major and generally expen-

²This section was prepared with the assistance of GLEN E. BERNATH, State soil conservationist, and RICHARD L. GOOGINS, assistant State soil scientist.

sive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible major reclamation.

In the capability system all 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 groupings, are designated by Roman numerals I through VIII. As the numerals increase, they indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

- Class I. Soils have few limitations that restrict their use.
- Class II. Soils have moderate limitations that reduce the choice of plants or 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 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. (None in Preble County.)
- Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, 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 without major reclamation and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral; for example, II*e*. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* is used in those areas where climate is the chief limitation to the production of common cultivated crops.

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, range, 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, II*e*-1 or III*e*-2. 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, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

In the following pages, each capability unit is briefly described and some suggestions for use and management are given. The soil series represented in each capability unit are mentioned in describing the unit. This does not mean, however, that all the soils of a series are in the capability unit. The reader can find the names of all the soils in a unit by referring to the "Guide to Mapping Units" at the back of this survey.

In the descriptions of capability units, depth of root zone means the depth to which roots can penetrate the soil to a restricting layer, such as a fragipan or a layer of dense clay; compact, limy till; or bedrock. For some capability units, reference is made to specialty crops. These are truck and nursery crops and tobacco.

In this section specific suggestions are not given for overcoming limitations of the soils. This is because many different methods or combinations of practices are suitable for controlling erosion or achieving artificial drainage on any given kind of soil. For specific information regarding management of the soils, the reader may contact the nearest office of the Soil Conservation Service or the Extension Service.

The following general, or basic, management practices are needed on practically all of the soils.

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 46 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. Practices of erosion control commonly used in the county are contour strip-

cropping, contour tillage, minimum tillage, constructing terraces, waterways, and diversions, utilizing crop residue, and planting close-growing crops.

CAPABILITY UNIT I-1

In this unit are nearly level, moderately well drained and well drained soils in uplands and on terraces. These soils are in the Birkbeck, Celina, Corwin, Dana, Kendallville, Ockley, Russell, Thackery, Tippecanoe, Wea, and Xenia series. They have a deep root zone and have few limitations that restrict their use.

The major management problems are maintaining high fertility and good soil structure.

These soils are suited to all crops commonly grown in the county. Under optimum management, they are suited to intensive cultivation of row crops. Large amounts of crop residues are needed to maintain soil structure.

These soils are well suited to grasses and legumes grown for hay or pasture and to trees and other vegetation grown for the development of wildlife habitats.

CAPABILITY UNIT IIe-1

This unit consists of soils that are deep or moderately deep, gently sloping, and moderately well drained and well drained. These are soils of the Celina, Corwin, Dana, Lewisburg, Miami, Milton, Kendallville, Ockley, Plattville, Russell, Tippecanoe, Thackery, Wynn, and Xenia series. The soils have adequate available moisture capacity and a moderately deep or deep root zone. The Wynn and Milton soils in this unit are moderately deep to limestone. Some of the soils in this unit are moderately eroded, and bouldery soils occur in the boulder belt.

The major management problem is the control of erosion. Maintaining high fertility and crop residues are secondary problems. The plow layer of the boulder soils needs to be cleared of stones and boulders before these soils can be cultivated.

The soils of this unit are suited to all crops commonly grown in the county. Under optimum management, row crops can be cultivated intensively where slopes are less than 4 percent. If a lower level of management is practiced, the cropping sequence should include close-growing crops, such as small grains, and sod or pasture crops that help to maintain soil structure and to control erosion.

These soils are well suited to grasses and legumes grown for hay or pasture. They are also suited to trees and other vegetation grown for wildlife habitats.

CAPABILITY UNIT IIe-2

This unit consists of well-drained, gently sloping soils that are medium textured. These soils are in the Fox series. They are underlain by strata of sand and gravel at a depth of 24 to 42 inches. Some of the soils are moderately eroded, and some are gravelly.

These soils are easy to cultivate. The root zone is typically moderately deep because of the underlying sand and gravel. The soils have low to medium available moisture capacity, however, and in dry years drought is a hazard.

The principal management problem is the control of erosion. Other problems are maintaining adequate fertility and enough crop residues to increase infiltration of water and to maintain good soil structure.

These soils are suited to crops commonly grown in the county, as well as to suitable specialty crops. Because of

limited available moisture capacity, the soils are better suited to early maturing crops than to those that mature late in summer. They are well suited to irrigation where water is available. Row crops can be grown continuously if erosion is controlled and if the highest practicable level of fertility and the maximum amount of crop residue are maintained. Use of less intensive management practices will result in lower yields and a greater hazard of erosion.

These soils are well suited to hay or pasture crops if enough vegetation is maintained to control erosion. They are also well suited to trees and to vegetation grown for wildlife developments; there is little or no risk of erosion once vegetation is established.

CAPABILITY UNIT IIw-1

The only soil in this unit is Shoals silt loam. This somewhat poorly drained soil is subject to flooding and has a seasonal high water table. Flooding normally occurs in winter and early in spring and, therefore, is little or no threat to most early maturing crops that are planted in spring.

This soil can be used continuously for row crops if improved management is practiced. There is little or no hazard of erosion. With or without improved drainage, this soil is suited to most of the commonly grown field crops and to hay and pasture plants. Adequate artificial drainage, however, will make the soil more suitable for row crops. The seasonal high water table can be lowered by tile drainage. Wetness can be lessened by the use of shallow ditches and by diversions at the bases of adjacent valley slopes.

This soil is also suited to trees and to development as wetland habitats for wildlife.

CAPABILITY UNIT IIw-2

This unit consists of medium-textured, somewhat poorly drained, nearly level and gently sloping soils. These soils are in the Celina, Crane, Crosby, Fincastle, Odell, Pymont, Raub, Reesville, and Sleeth series. Some of them are in the uplands, and some are on terraces.

These soils have medium or high available moisture capacity and a moderately deep or deep root zone. All have a high water table in winter and spring.

The major management problem is removal of excess water from the soils. A secondary problem is control of erosion in the gently sloping areas.

When adequately drained, these soils are suited to most field crops commonly grown in the county. Row crops can be grown continuously on slopes of up to 4 percent if optimum management is used. All of the soils, except the Pymont, can be adequately drained by tile. The Pymont soils can be drained by surface ditches and bedding systems. Even when drained, however, Pymont soils are not so well suited to corn as the other soils. Also, they need to be tilled with a narrower range of moisture content than the other soils in the unit. Large amounts of crop residues need to be returned to all the soils, particularly the light-colored ones, to maintain good soil structure and tilth. Cropping systems on the gently sloping soils should provide for erosion control.

These soils are well suited to grasses and legumes grown for pasture and hay, as well as trees and other vegetation grown for wildlife developments. There is little or no erosion hazard if vegetative cover is maintained.

CAPABILITY UNIT IIw-3

This unit consists of nearly level, well drained and moderately well drained soils that are subject to flooding. The soils are in the Landes, Medway, and Ross series. The Medway and Ross soils have high available moisture capacity, and the Landes, medium available moisture capacity. The soils have a deep root zone.

Flooding is the major hazard. Tillage is a problem in some areas of Landes gravelly sandy loam.

These soils are suited to most of the commonly grown field crops, but flooding late in winter or early in spring can damage winter grain crops. Nevertheless, row crops can be grown continuously if optimum management is used. Yields are favorable under optimum management, which should include growing of cover crops in areas subject to scouring during floods. Large amounts of crop residues need to be returned to the soil to maintain good tilth.

The installation of dikes or levees to prevent flooding would eliminate all or most limitations to the use of these soils. Internal drainage is generally good, but there are some wet spots. The wet spots can be drained by random tile systems or surface ditches.

These soils are well suited to grasses and legumes grown for hay or pasture and also to trees.

CAPABILITY UNIT IIw-4

This unit consists of very poorly drained soils. These soils are in the Bonpas, Brookston, Ragsdale, and Westland series. They are mostly in nearly level and depression areas of the uplands, but some of them are on terraces.

When artificially drained, the soils have high available moisture capacity and a deep root zone. Most of them have a high content of organic matter.

The major management problem is restricted natural drainage. The soils can be cultivated intensively if they are artificially drained and if other optimum management is practiced. They can be tilled only within a narrow range of moisture content, however. If tilled when wet, the soils become compacted and cloddy. The silty clay loam soils are particularly subject to surface cloddiness. Drained areas of these soils are among the most productive in the county.

The soils in this unit can easily be drained by tile. Shallow surface ditches are also suitable. The water table is high for long periods in areas that are not drained.

In drained areas, these soils are suited to grasses and legumes grown for hay or pasture. They should not be pastured when wet, so as to avoid compaction. The soils are suited to trees and other vegetation grown for wildlife habitats.

CAPABILITY UNIT IIe-1

This unit consists of medium-textured, nearly level soils that are well drained. These soils are in the Fox, Milton, and Warsaw series. They are moderately deep to underlying sand and gravel or to limestone. They have low to medium available moisture capacity and a moderately deep root zone.

The major management problem is the conservation of moisture, but maintaining high fertility and enough crop residues are related problems.

These soils are suited to most field crops commonly grown, and to specialty crops. Row crops can be grown continuously under optimum management. The soils are well suited to irrigation. Large amounts of crop residues

are needed to help water enter the soils and to maintain soil structure.

The soils in this unit are suited to grasses and legumes grown for hay and pasture, and also to trees. Pastures need to be irrigated to provide good growth through the summer.

CAPABILITY UNIT IIIe-1

In this unit are well drained and moderately well drained, sloping soils. These are soils of the Celina, Miami, Milton, Kendallville, Ockley, Russell, and Wynn series. They are on uplands and on some terraces. These soils have either medium or high available moisture capacity. Some are moderately eroded. The root zone is moderately deep in some soils and deep in others. The Wynn and Milton soils are moderately deep over limestone.

The major management problem is the control of erosion. Maintaining adequate fertility and enough crop residues are also problems.

These soils are suited to field crops commonly grown in the county. If erosion is controlled, row crops can be grown frequently. Control of erosion is difficult, however, when these soils are cultivated continuously. Some soils in the boulder belt need to have boulders removed from the plow layer before they can be cultivated. Under optimum management the cropping system should include close-growing crops and also grasses and legumes that provide large amounts of crop residues.

These soils are well suited to grasses and legumes grown for hay or pasture, and also to trees and other vegetation grown for wildlife developments.

CAPABILITY UNIT IIIe-2

The soils in this unit are medium textured, sloping, and well drained. They are soils of the Fox series. Strata of sand and gravel occur below depth of 2 to 3½ feet. These soils have medium to low available moisture capacity as a result of the limited depth to sand and gravel.

The major limitation of these soils is the hazard of erosion. Drought is a moderate hazard.

These soils are easy to cultivate and are suited to field and specialty crops commonly grown in the county. Because of the hazard of drought, they are better suited to early maturing crops than those that mature late in summer. Large amounts of crop residues are essential to help water enter the soil and to maintain soil structure. Row crops can be grown, but they should be used in a cropping system that includes crops other than those that are clean tilled. Close-growing crops and grasses and legumes help to control erosion and furnish large amounts of crop residues. These soils can be irrigated if erosion is controlled.

Drought-resistant varieties of grasses and legumes should be grown for hay or pasture. If enough vegetation is maintained, there is little hazard of erosion when the soils are used for hay, pasture, or trees.

CAPABILITY UNIT IIIe-3

This unit consists of severely eroded soils that are gently sloping and well drained and moderately well drained. The soils are in the Celina and Miami series.

Erosion has removed the original surface soil and thereby reduced the depth of the root zone. The available moisture capacity is mostly low. The surface layer is now mostly subsoil material, and tilth is generally poor. The soils can be tilled best within only a narrow range of

moisture content. If worked when too wet, they become cloddy and puddled.

The major management problem is the control of erosion. Other management problems are maintaining adequate fertility and returning enough crop residues to the soil to maintain its structure.

These soils can be used for most crops commonly grown in the county, but they tend to be droughty as a result of being severely eroded. A conservation cropping system should include close-growing crops and suitable grasses and legumes. These are needed to provide enough crop residues to maintain good tilth and soil structure and to help control erosion.

These soils can be used for permanent hay, pasture, or trees. Drought-resistant varieties of grasses and legumes should be grown for hay or pasture. Pastures are less productive during dry summer months because of the limited available moisture capacity. A vegetative cover should be maintained to control erosion.

CAPABILITY UNIT IIIw-1

This unit consists of somewhat poorly drained and very poorly drained, nearly level to gently sloping soils of the Millsdale and Randolph series. These soils are underlain by limestone or calcareous shale bedrock, in most places at depths of 20 to 40 inches.

The soils can be tilled best within only a narrow range of moisture content. If tilled when wet, they become compact and cloddy. The Randolph soils are more subject to surface crusting than the Millsdale.

Improved drainage is the major management requirement. Erosion control is a problem on gently sloping areas.

These areas are suited to most of the field crops commonly grown. Row crops can be grown continuously if they are drained and if other optimum management practices are used. Hay and pasture plants tolerant of some wetness are better suited to these soils than plants that require dry sites. The soils can be drained by tile. Bedrock interferes with the installation of tile lines in some places, however. In these places surface ditches can be installed. In undrained areas the water table is high for long periods.

Both drained and undrained areas of the Randolph soils are suited to grasses and legumes grown for hay or pasture. The Millsdale soils are suited to grasses and legumes after drainage has been improved. They become compacted if pastured when too wet.

The soils of this unit are also suited to trees and other vegetation grown for wildlife developments.

CAPABILITY UNIT IIIw-2

The only soil in this unit is Sloan silt loam. This soil is nearly level and very poorly drained. It lies on flood plains and is likely to be flooded periodically. It has high available moisture capacity, and when drained, it has a deep root zone.

Because it occupies low areas along streams, this soil has a high water table for long periods. The high water table and a hazard of flooding are the major management problems.

This soil is suitable for most crops commonly grown in the county, particularly those that tolerate wetness. It can be cultivated intensively with little or no hazard of erosion, but large amounts of crop residues are needed to maintain

soil structure and tilth. The soil can be tilled best within only a narrow range of moisture content.

This soil can be drained adequately by tile, except where outlets are hard to obtain because of high stream channels. In these areas, it can be partly drained by surface ditches. Flooding can be lessened by diverting surface runoff from higher adjacent areas.

When drained, this soil can be used for suitable grasses and legumes grown for hay or pasture. If it is pastured while wet, the soil may become compacted.

This soil is suited to trees and other vegetation used for wildlife habitats.

CAPABILITY UNIT IIIs-1

The only soil in this unit is Landes sandy loam, gravelly subsoil variant. This well drained, nearly level soil is on bottom lands that are subject to flooding. It is underlain by beds of gravel at a depth of 13 to 28 inches.

This soil has low available moisture capacity and a shallow to moderately deep root zone. The major limitations to its use are the limited available moisture capacity and droughtiness. A secondary problem is the hazard of occasional flooding.

This soil is suited to crops commonly grown in the county. Early planting and the growing of short-season crops will help prevent damage by drought. Large amounts of crop residues should be used to help maintain soil structure and to help retain soil moisture. Fall-planted small grains are likely to be damaged by flooding in winter and early in spring. This soil is well suited to irrigation. Drought-tolerant varieties of plants should be grown, however, where the soil is not irrigated.

This soil is suited to grasses and legumes, as well as to trees.

CAPABILITY UNIT IVe-1

This unit consists mostly of well-drained soils that are moderately steep. These soils are in the Fox, Kendallville, Miami, Ockley, and Russell series. They occupy uplands and terraces. The soils have a moderately deep to shallow root zone and low to medium available moisture capacity. Some of them are moderately eroded.

The major management problem is the control of erosion. The risk of erosion is great if the soils are cultivated without adequate protection.

These soils are suited to most crops commonly grown in the county. A cropping system that limits the growing of clean-cultivated crops and includes close-growing crops and grasses and legumes should be used, along with other conservation practices. Large amounts of crop residues need to be incorporated into the soil to help maintain soil structure and control erosion.

These soils are suited to hay and pasture crops. A good cover of vegetation is needed for best control of erosion. The soils are also suited to trees and to other vegetation grown for wildlife developments.

CAPABILITY UNIT IVe-2

This unit consists of well-drained, gently sloping to sloping soils, most of which are severely eroded. These soils are in the Channahon, Fox, Kendallville, Lewisburg, Miami, Milton, Ockley, Ritchey, and Russell series. They occupy uplands and terraces. They have a shallow or moderately deep root zone and low to medium available moisture capacity. The Milton soils are moderately deep to

limestone bedrock, and the Ritchey and Channahon soils are shallow to limestone bedrock.

The major management problem is the control of erosion. Other problems are the maintenance of good soil structure and adequate fertility. Erosion has removed most of the original surface layer of the soils, and, therefore, good tilth is difficult to maintain.

These soils are suited to crops commonly grown in the county. If they are cultivated, the cropping system should include close-growing crops and grasses and legumes. Large amounts of crop residues need to be returned to the soil to maintain good structure.

Drought-resistant grasses and legumes can be grown for pasture and hay. Pastures do not do well during the dry summer months. If good vegetative cover is maintained, however, there is little hazard of erosion.

These soils are also suited to trees and other vegetation grown for wildlife developments.

CAPABILITY UNIT VIe-1

This unit consists of soils that are moderately steep, steep, and very steep and moderately or severely eroded (fig. 4). These soils are in the Channahon, Fairmount, Fox, Hennepin, Kendallville, Miami, Ockley, Ritchey, and Russell series. The Ritchey, Channahon, and Fairmount soils are shallow to limestone.

Because of slopes, past erosion, and a continuing hazard of erosion, the soils in this unit are not suitable for cultivated crops. They are suited to permanent pasture consisting of grasses and legumes. Erosion is a serious hazard when pasture is reseeded or when adequate vegetative cover is not maintained. Grazing should be regulated so as to maintain enough vegetation to control erosion. Adequate fertility also needs to be maintained.

These soils are also suited to trees and other vegetation grown for wildlife developments.

CAPABILITY UNIT VIIe-1

This unit consists of Gullied land and soils of the Channahon, Fox, Hennepin, Miami, and Ritchey series. These soils are moderately or severely eroded and most of them are very steep. The Ritchey and Channahon soils,



Figure 4.—An active gully that has cut into the deep glacial till underlying some of the soils of capability unit VIe-1. Miami, Fox, and Hennepin soils are adjacent to the gully.

which are shallow to limestone, are sloping to moderately steep. The soils in this unit have low available moisture capacity.

The major management problem is the control of erosion. Erosion has removed the surface soil and caused gullying in most of the soils. Surface runoff is very rapid. Surface tilth is very poor for the growth of desirable plants.

These soils should not be cultivated. They can be used for permanent pasture or planted to trees. They can also be used for suitable vegetation grown for wildlife developments. If the soils are planted to permanent pasture, grazing should be controlled so as to maintain a good cover that will help to control erosion. Grading is needed in many places before gullied areas can be seeded.

CAPABILITY UNIT VIIIs-1

This unit consists of soils of the Casco, Fox, and Rodman series. These soils are sloping to very steep and shallow to the underlying sand or gravel. They are very droughty. They have a serious hazard of erosion, as well as unfavorable physical characteristics.

These soils are not suited to cultivated crops. They can be used for very limited grazing or permanent pasture. Trees suitable for dry areas can be planted, as well as plants for wildlife habitats. Adequate cover should be maintained at all times to help control erosion.

CAPABILITY UNIT VIIIIs-1

This unit consists of Gravel pits, Quarries, Riverwash, and Made land and Borrow pits. These miscellaneous land types have little or no agricultural value. They have some commercial value, and some areas can be developed for wildlife and recreation.

Estimated Yields

Table 1 shows for soils in the county suited to crops the estimated average acre yield of principal crops that can be expected over a period of years under two levels of management, improved and optimum. In columns A are estimates of yields obtained under the improved management practices commonly used in the county in 1961.

In columns B are estimates of yields obtained under optimum management—application of the best information available. The following management practices must be carried out near the highest level to obtain the yields given for optimum management:

1. Water relationship within the soil is maintained at the optimum level for crop growth. Measures are used to increase water intake and water-holding capacity of the soil. An excessive water problem is corrected by appropriate practices, including installation of tile drains or surface drains, land smoothing, or a combination of these practices.
2. If erosion is a hazard, or if some erosion has already occurred, such erosion-control practices as diversions, terraces, contour farming, and contour stripcropping are applied.
3. Appropriate tillage practices, including the time of tillage, plowing, seedbed preparation, and weed and insect control are adapted to the soil conditions and the specific crop.

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

[Yield estimates in columns A are based on improved management, and estimates in columns B are based on optimum management. (See the text for an explanation of the two levels of management.) Absence of a yield figure indicates that the crop is not commonly grown at the level of management indicated or that the soil is not suited to the crop. Soils and miscellaneous land types not considered suitable for crops are not listed in the table]

Soil	Corn		Wheat		Oats		Soybeans		Legume-grass hay	
	A	B	A	B	A	B	A	B	A	B
Birkbeck silt loam, 0 to 2 percent slopes	90	105	28	45	50	75	30	35	2.6	3.6
Bonpas silt loam	85	120	26	40	55	85	28	40	3.0	5.0
Bonpas silty clay loam	80	115	24	38	48	75	28	38	3.0	4.5
Brookston silt loam, 0 to 2 percent slopes	80	115	30	45	50	80	28	40	3.0	4.5
Brookston silty clay loam, 0 to 2 percent slopes	80	115	30	45	50	80	28	38	3.0	4.5
Celina bouldery silt loam, 2 to 6 percent slopes ¹	60	95	28	40	42	70	24	34	2.5	4.0
Celina silt loam, 0 to 2 percent slopes	60	95	28	40	45	75	24	34	2.5	4.0
Celina silt loam, 2 to 6 percent slopes	60	95	28	40	45	75	24	34	2.5	4.0
Celina silt loam, 2 to 6 percent slopes, moderately eroded	50	92	22	36	38	64	18	30	2.4	3.4
Celina-Miami silt loams, 6 to 12 percent slopes, moderately eroded	40	75	20	34	32	58	16	24	1.9	3.0
Channahon and Fairmount soils, 18 to 25 percent slopes, moderately eroded									1.3	2.7
Corwin silt loam, 0 to 2 percent slopes	75	100	26	40	46	72	28	34	3.0	4.5
Corwin silt loam, 2 to 6 percent slopes	70	100	26	38	46	70	26	34	3.0	4.5
Crane silt loam	80	110	28	38	44	80	28	38	2.5	4.5
Crosby bouldery silt loam, 0 to 2 percent slopes ¹	65	95	26	36	42	70	22	34	2.0	3.4
Crosby bouldery silt loam, 2 to 6 percent slopes ¹	65	90	26	36	40	70	20	32	2.5	4.0
Crosby silt loam, 0 to 2 percent slopes	65	95	26	36	42	70	22	34	2.5	4.0
Crosby-Celina silt loams, 2 to 6 percent slopes	50	90	22	34	40	66	22	32	2.0	3.4
Dana silt loam, 0 to 2 percent slopes	75	115	28	44	48	76	28	38	3.0	4.5
Dana silt loam, 2 to 6 percent slopes	75	110	32	44	48	74	28	36	3.0	4.5
Fincastle silt loam, 0 to 2 percent slopes	70	100	26	36	44	72	24	36	2.0	4.0
Fincastle silt loam, 2 to 6 percent slopes	75	105	22	38	42	75	22	38	2.0	4.0
Fox gravelly loam, 0 to 2 percent slopes	45	85	20	35	45	70	16	26	2.2	3.5
Fox gravelly loam, 2 to 6 percent slopes	45	75	20	30	36	60	16	26	2.0	3.4
Fox gravelly loam, 2 to 6 percent slopes, moderately eroded	40	70	18	26	32	50	14	24	1.8	3.2
Fox gravelly loam, 6 to 12 percent slopes, moderately eroded	35	65	16	22	26	50	12	20	1.6	2.8
Fox loam, 0 to 2 percent slopes	55	95	26	40	50	76	22	30	3.0	4.0
Fox loam, 2 to 6 percent slopes	55	90	24	36	46	70	20	28	2.4	3.6
Fox loam, 2 to 6 percent slopes, moderately eroded	50	85	22	36	44	68	18	26	2.2	3.4
Fox loam, 6 to 12 percent slopes, moderately eroded	40	75	20	32	36	58	16	24	2.0	3.2
Fox silt loam, 0 to 2 percent slopes	60	95	26	40	50	76	24	32	3.0	4.2
Fox silt loam, 2 to 6 percent slopes	55	95	26	38	50	76	22	32	2.5	3.8
Fox silt loam, 2 to 6 percent slopes, moderately eroded	50	92	24	36	46	72	20	30	2.4	3.6
Fox silt loam, 6 to 12 percent slopes, moderately eroded	50	80	22	34	40	68	18	26	2.2	3.2
Fox silt loam, 12 to 18 percent slopes, moderately eroded	40	70	16	22	30	56	16	22	1.8	3.0
Fox soils, 6 to 12 percent slopes, severely eroded	35	60	16	22	30	56	16	22	2.0	3.0
Fox soils, 12 to 18 percent slopes, severely eroded									1.4	2.5
Landes gravelly sandy loam	55	80	24	32	40	62	22	30	2.5	3.8
Landes sandy loam	70	105	32	40	46	76	28	34	2.9	4.5
Landes sandy loam, gravelly subsoil variant	55	80	24	32	35	55	22	30	2.4	3.4
Lewisburg silt loam, 2 to 6 percent slopes	50	75	20	32	35	60	20	30	2.2	3.3
Lewisburg silt loam, 2 to 6 percent slopes, moderately eroded	45	70	18	30	35	55	14	26	2.0	3.1
Lewisburg soils, 6 to 12 percent slopes, severely eroded	20	60	10	20	20	45	6	18	1.6	2.8
Medway silt loam	90	120	32	40	54	80	32	38	3.0	5.0
Miami bouldery silt loam, 6 to 12 percent slopes, moderately eroded ¹	45	80	24	33	32	55	20	24	2.5	3.5
Miami silt loam, 6 to 12 percent slopes	50	85	24	36	40	65	20	28	2.5	4.0
Miami silt loam, 6 to 12 percent slopes, moderately eroded	45	80	20	33	32	55	16	24	2.5	3.5
Miami silt loam, 12 to 18 percent slopes	45	65	22	32	34	50	16	26	1.9	3.0
Miami silt loam, 12 to 18 percent slopes, moderately eroded	35	60	18	26	28	45	12	20	1.5	2.8
Miami soils, 6 to 12 percent slopes, severely eroded	30	50	16	26	24		10	18	1.5	2.8
Miami soils, 12 to 18 percent slopes, severely eroded									1.3	2.5
Miami-Celina bouldery silt loams, 2 to 6 percent slopes ¹	60	85	24	36	42	70	24	34	2.5	3.5
Miami-Celina bouldery silt loams, 2 to 6 percent slopes, moderately eroded ¹	50	85	22	34	38	64	18	28	2.4	3.4
Miami-Celina silt loams, 2 to 6 percent slopes	60	85	26	36	44	72	26	34	2.6	3.6
Miami-Celina silt loams, 2 to 6 percent slopes, moderately eroded	50	85	24	36	38	62	20	28	2.5	3.8
Miami-Celina soils, 2 to 6 percent slopes, severely eroded	30	50	20	30	30	50	14	24	1.8	2.5
Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, moderately eroded									1.3	3.0

See footnote at end of table.

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

Soil	Corn		Wheat		Oats		Soybeans		Legume-grass hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons	Tons
Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, severely eroded.....									1.3	3.0
Millsdale silt loam, 0 to 3 percent slopes.....	65	105	30	45	46	74	24	40	2.7	4.2
Millsdale silty clay loam, 0 to 3 percent slopes.....	65	100	24	38	46	74	24	36	2.7	4.2
Milton silt loam, 0 to 2 percent slopes.....	55	90	26	38	46	72	22	32	2.2	3.6
Milton silt loam, 2 to 6 percent slopes.....	55	85	24	38	44	72	22	30	2.2	3.6
Milton silt loam, 2 to 6 percent slopes, moderately eroded.....	40	80	22	34	38	54	16	24	2.0	3.0
Milton silt loam, 6 to 12 percent slopes, moderately eroded.....	35	70	20	32	32	50	12	20	1.4	2.6
Milton soils, 6 to 12 percent slopes, severely eroded.....	24	60	16	24	24	45	8	16	1.0	2.3
Ockley silt loam, 0 to 2 percent slopes.....	65	105	28	44	50	80	26	36	3.0	4.5
Ockley silt loam, 2 to 6 percent slopes.....	65	105	28	42	50	80	24	36	3.0	4.5
Ockley and Kendallville silt loams, 0 to 2 percent slopes.....	65	100	26	40	46	74	28	36	2.6	3.6
Ockley and Kendallville silt loams, 2 to 6 percent slopes.....	65	100	26	40	46	74	26	34	2.6	3.6
Ockley and Kendallville silt loams, 2 to 6 percent slopes, moderately eroded.....	50	90	24	38	38	66	20	28	2.5	3.5
Ockley and Kendallville silt loams, 6 to 12 percent slopes, moderately eroded.....	45	80	20	34	32	50	16	24	1.9	3.0
Ockley and Kendallville silt loams, 12 to 18 percent slopes, moderately eroded.....	35	65	16	28	28	45	10	18	1.5	2.8
Ockley and Kendallville soils, 6 to 12 percent slopes, severely eroded.....	30	50	16	24	24	45	10	18	1.5	2.8
Ockley and Kendallville soils, 12 to 18 percent slopes, severely eroded.....									1.0	2.5
Odell silt loam, 2 to 6 percent slopes.....	70	110	22	28	42	75	24	34	2.2	4.0
Plattville silt loam, 2 to 6 percent slopes.....	65	95	26	38	46	75	24	32	2.3	3.8
Pyrmont silt loam, 0 to 2 percent slopes.....	35	60	16	30	32	56	16	28	1.7	3.2
Pyrmont silt loam, 2 to 6 percent slopes.....	35	60	16	30	30	54	16	28	1.7	3.2
Ragsdale silt loam.....	90	120	26	45	54	80	34	42	3.3	5.0
Randolph silt loam, 0 to 2 percent slopes.....	60	85	26	34	36	70	20	32	2.5	4.0
Randolph silt loam, 2 to 6 percent slopes.....	60	90	18	32	36	70	20	30	2.5	4.0
Raub and Dana silt loams, 0 to 2 percent slopes.....	75	110	24	38	44	70	26	38	2.3	3.6
Reesville silt loam, 0 to 2 percent slopes.....	75	110	20	34	46	70	28	34	2.3	3.5
Ritchey and Channahon silt loams, 2 to 6 percent slopes, moderately eroded.....									1.8	2.7
Ritchey and Channahon silt loams, 6 to 12 percent slopes, moderately eroded.....									1.1	2.2
Ritchey and Channahon silt loams, 12 to 18 percent slopes, moderately eroded.....									1.0	1.6
Ross loam.....	90	125	34	45	54	78	32	38	3.1	5.0
Russell silt loam, 0 to 2 percent slopes.....	70	110	28	40	50	76	30	38	2.8	3.8
Russell silt loam, 2 to 6 percent slopes.....	70	105	28	42	48	74	28	36	2.7	3.7
Russell silt loam, 2 to 6 percent slopes, moderately eroded.....	55	95	28	42	40	74	22	33	2.6	3.6
Russell silt loam, 6 to 12 percent slopes, moderately eroded.....	50	90	28	40	34	70	24	30	2.1	3.2
Russell silt loam, 12 to 18 percent slopes, moderately eroded.....	40	70	18	32	30		14	22	1.8	3.1
Russell soils, 6 to 12 percent slopes, severely eroded.....	35	55	16	26	26	55	12	20	1.7	3.0
Russell soils, 12 to 18 percent slopes, severely eroded.....									1.3	2.7
Shoals silt loam.....	65	105	24	38	46	70	28	34	2.3	4.0
Sleeth silt loam, 0 to 2 percent slopes.....	60	100	24	36	44	75	26	34	2.3	3.4
Sloan silt loam.....	75	105	22	38	42	70	26	36	2.7	4.2
Thackery silt loam, 0 to 2 percent slopes.....	65	105	28	44	50	80	24	34	2.7	4.1
Thackery silt loam, 2 to 6 percent slopes.....	65	100	26	44	48	74	22	32	2.7	4.1
Tippecanoe silt loam, 0 to 2 percent slopes.....	85	115	30	38	52	76	22	32	2.9	4.4
Tippecanoe silt loam, 2 to 6 percent slopes.....	85	115	30	38	52	76	22	32	2.9	4.4
Warsaw silt loam, 0 to 2 percent slopes.....	75	110	28	40	52	76	24	36	2.7	4.5
Wea silt loam, 0 to 2 percent slopes.....	90	120	32	45	54	80	30	40	3.1	4.6
Westland silt loam.....	80	115	26	40	48	76	28	38	3.0	4.5
Westland silty clay loam.....	80	115	24	38	46	74	28	38	3.0	4.5
Wynn silt loam, 2 to 6 percent slopes.....	55	90	24	38	38	68	22	34	2.4	3.5
Wynn silt loam, 2 to 6 percent slopes, moderately eroded.....	50	80	26	36	40	68	22	30	2.3	4.0
Wynn silt loam, 6 to 12 percent slopes, moderately eroded.....	50	75	26	36	38	68	20	30	2.0	4.0
Xenia silt loam, 0 to 2 percent slopes.....	65	105	26	40	46	75	26	36	2.5	4.0
Xenia silt loam, 2 to 6 percent slopes.....	65	105	26	40	46	75	24	34	2.5	4.0
Xenia silt loam, 2 to 6 percent slopes, moderately eroded.....	55	90	24	38	40	70	20	28	2.4	3.5

¹ Yields given can be obtained if boulders are removed.

4. The fertility and pH of the soil are maintained at optimum levels. Trace elements are supplied by fertilizer as required.
5. All practices are conducted at a time when they will contribute most toward efficient production.
6. Adapted high-yield crop varieties are used.

These estimated yields are not static values but are designed to indicate the productivity of the soils. The yield figure is influenced by soil characteristics and indicates how desirable these characteristics may be for crop production. Consequently, the relative productivity of a soil is evident when its yield figures are compared with those of the other soils in the county. Estimated yields may change as research opens new areas in production technology, but the relative productivity of a soil is not likely to change.

The estimates in table 1 are based on interviews with farmers, observations and field trials of the county agricultural extension agent and work unit conservationists of the Soil Conservation Service, experimental results of the Ohio Agricultural Research and Development Center, and direct observations by members of the soil survey party.

The yield figures do not apply directly to any specific field for any particular year, because the soils vary from place to place and management practices differ from farm to farm. Also, weather conditions vary from year to year. The estimates are intended only as a general guide to the relative productivity of the soils and an indicator of how the soils respond to optimum management, as compared to response under improved management.

Woodland Uses of the Soils

Originally, nearly all of the county was covered by mixed hardwood forest. Most of the forest has now been cleared. The remaining areas of woodland are on soils that are naturally wet and undrained and on other soils not presently being farmed. Most of the woodland is in small farm woodlots.

Past methods of harvesting have resulted in low-quality trees in most woodlots. The best species of trees were harvested and inferior species were allowed to grow. With proper management, however, most woodland in the county will increase in value.

Table 2 gives, for six major soil series in the county, the site-index data from a few plots and average estimated yearly growth per acre for one or more important species of trees. Site index is a standard of forest quality expressed as height of a given species at a specified age, usually 50 years. The average estimated yearly growth per acre is for managed stands.

For specific information about managing woodland on individual soils in Preble County, the reader should contact the local soil conservationist or the local agricultural extension office.

Soils and Wildlife Habitats

Wildlife is an important natural resource in Preble County. The original wildlife population included many small game animals and some larger animals, such as deer. Since the early settlement and clearing of the land, the kind, distribution, and quantity of wildlife have changed.

TABLE 2.—*Site-index data and estimated yearly growth of oaks and tulip-poplar for some major soil series*

Soil series	Species of trees	Number of plots	Average site index ¹	Average yearly growth per acre
Brookston	Swamp white oak	2	70-80	<i>Board feet</i> 253-330
Celina	Red oak	1	90-100	426-526
	White oak	1	80-90	330-426
	Tulip-poplar	1	² 105-115	² 600
Crosby	White oak	1	65-75	218-290
	Red oak	1	70-80	253-330
	Tulip-poplar	1	² 85-95	² 450
Fincastle	Red oak	1	80-90	330-426
	Tulip-poplar	1	² 85-95	² 450
Fox	Red oak	1	80-90	330-426
Miami	Red oak	2	80-90	330-426

¹ International 1/8-inch rule, 70-year rotation (8).

² Site index from Renshaw and Doolittle (?); growth per acre is estimated.

It is difficult to correlate the kinds and numbers of wildlife with specific soils because changes in land-use patterns can change wildlife distribution. Such soil properties as slope, productivity potential, texture, and effective depth influence the use of the land. These factors, along with the type of topography, largely control the amount of food, water, and cover available for wildlife. Therefore, to a great extent, they influence the kinds and numbers of wildlife in any area.

The kinds and numbers of wildlife in the county can be correlated, in a general way, with the eleven soil associations. (See the section "General Soil Map.") The soil associations have been grouped into two wildlife habitat areas. A discussion of both areas follows. After this there are some general comments regarding soils and land use and their relationship to wildlife.

Wildlife habitat area 1

This area consists of soil associations 1, 8, 9, and 10. It is characterized by steep valley walls, hummocky kamelike topography, and adjacent stream terraces and bottom lands. Suitable areas are farmed intensively. The steep valley walls and steeper terrace areas are wooded; some of these are used for pasture.

Few pheasants inhabit this area, particularly the steep, wooded parts. Pheasants, however, are more common in the bottom lands adjacent to areas in the soil associations of habitat area 2. Quail, rabbits, squirrels, raccoons, skunks, and opossums are common in this area. Bushy areas along streams provide ideal cover for quail and rabbits. The wooded slopes and forested bottom lands, interspersed with grainfields, provide ideal conditions for squirrels and raccoons. The many kinds of birds are important for insect control.

Wildlife habitat area 2

This area consists of soil associations 2, 3, 4, 5, 6, 7, and 11. Together, these associations make up most of the county. Most of the land in this area is used intensively for corn, soybeans, small grains, and meadow. Pheasants and quail thrive because of an abundance of grain crops.

Quail are more numerous than pheasants. Although there are not many pheasants, they are most numerous in the Boston Plains area of soil association 3. They are almost as numerous in soil associations 2, 4, and 5, but less so in soil associations 6 and 7. The intensive use of the land also provides much grain and other seeds for many nongame birds that are important for insect control, as well as esthetic purposes.

Many nearly level areas of the Brookston, Crosby, and Fincastle soils consist of fairly large farm woodlots. Generally, there are many large, hollow beech trees on these naturally wet soils. These provide ideal dens for raccoons and other wildlife. Where undrained, these wet soils are not generally suitable for rabbits and quail. Nevertheless, rabbits and quail, as well as fox, red squirrels, and raccoons, are common throughout this habitat area. Large-mouth bass and bluegill abound in the many farm ponds and lakes that produce most of the fish in the county.

* * * * *

All of the soils in the county are suitable for some kind of development for elements of wildlife habitats. The soils in capability classes I and II are farmed so intensively that few ideal areas remain for wildlife shelter. The soils in capability classes III and IV generally include odd areas or steep slopes that can be developed for wildlife cover. The soils in capability classes VI and VII are commonly in uses that provide good cover for wildlife.

The planting of vegetation suitable for wildlife in odd areas, around farm ponds, and along field and woodland borders will help to maintain and increase the wildlife population.

Technical assistance in developing wildlife habitats and in stocking reservoirs with fish can be obtained from the local office of the Soil Conservation Service, the county agent, the State forester, the Ohio Department of Natural Resources, and the U.S. Fish and Wildlife Service.

Engineering Uses of the Soils

During the making of a soil survey, much information is discovered about the properties of the soils and materials from which they have formed. When properly interpreted, much of this information can be very useful to agricultural, civil, construction, and highway engineers and to anyone else whose work involves the use of soil mechanics or soil engineering data.

This section has been prepared specifically to interpret the characteristics of the soils of the county for soil engineering uses. Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. The properties most important to engineering use are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Depth to the water table, depth to bedrock, and topography also are important.

Information in this survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing business, residential, recreational, and light industrial sites.

2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel and other construction material.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that will be useful in designing and maintaining engineering practices and 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 to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Used with the soil map to identify the soils, the engineering interpretations in this section can be useful for many purposes. It should be emphasized that the interpretations may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of the layers reported. Nevertheless, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used by the soil scientists may be unfamiliar to engineers, and some words may have special meanings in soil science. These and other terms are defined in the Glossary at the end of the survey.

Engineering classification systems

Many highway engineers classify soil material according to the system adopted by the American Association of State Highway Officials (AASHTO) (1). In this system, soil materials are classified into seven principal groups. The groups range from A-1, which is soil of high bearing capacity, to A-7, which consists of clay soil having low strength when wet.

Some engineers prefer to use the Unified soil classification system (17). In this system, soil materials are identified as coarse grained, eight classes; fine grained, six classes; and highly organic. An approximate classification of soils can be made in the field. (See table 3 for the Unified and AASHTO classification of soils tested in Preble County.)

Engineering soil test data

Soil samples from seven of the principal soil series in Preble County were tested according to standard AASHTO procedures to help evaluate the soils for engineering purposes. Table 3 gives the results of these tests. The engineering classifications in this table are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits.

TABLE 3.—Engineering test data ¹ for soil

Soil name and location	Parent material	Ohio report number	Depth from surface	Horizon	Moisture-density ²	
					Maximum dry density	Optimum moisture
			<i>Inches</i>		<i>Lb. per cu ft.</i>	<i>Percent</i>
Brookston silty clay loam: NE ¹ / ₄ SE ¹ / ₄ NE ¹ / ₄ sec. 2, Harrison Twp-----	Silty pedis sediment over till.	42253	0-10	A		
		42254	10-27	Bg		
		42255	27-50	C		
Celina silt loam: 1,450 feet west and 390 feet south of north-east corner of NE ¹ / ₄ sec. 10, Monroe Twp.	Glacial till.	43737	0-7	Ap		
		43738	7-18	B		
		43739	18-41	C		
Crosby silt loam: NW ¹ / ₄ NW ¹ / ₄ SW ¹ / ₄ sec. 26, Monroe Twp-----	Glacial till.	43740	0-9	A		
		43741	9-28	Bg		
		43742	28-60	C		
Fox silt loam: SE ¹ / ₄ NW ¹ / ₄ sec. 27, Lanier Twp-----	Outwash material.	41061	0-8	Ap	113	14
		41062	8-24	B	100	21
		41063	24-36	C	132	10
Ragsdale silt loam: NW ¹ / ₄ NW ¹ / ₄ sec. 30, Jackson Twp-----	Loess.	43734	0-10	Ap		
		43735	10-46	Bg		
		43736	46-60	C		
Reesville silt loam: SE ¹ / ₄ NE ¹ / ₄ SW ¹ / ₄ sec. 30, Jackson Twp-----	Loess over glacial till.	42256	0-8	A	102	21
		42257	8-36	B	106	19
		42258	36-76	C	114	15
Russell silt loam: NW ¹ / ₄ SW ¹ / ₄ sec. 36, Israel Twp-----	Loess over glacial till of late Wisconsin age.	42259	0-8	Ap		
		42260	8-48	B		
		42261	48-98	C		

¹ Tests performed by the Ohio Department of Highways in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (1).

² Based on the Moisture-density Relations of Soils Using 5.5-lb. Rammer and 12-in. Drop, AASHO Designation T 99-57, Method A (1).

³ According to AASHO Designation T 88-57 (1). Results by this procedure frequently may differ somewhat from results that would have been 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 used in this table are not suitable for use in naming textural classes for soil.

The mechanical analyses were made by using a combination of the sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used in naming USDA textural classes, since size classes for engineering purposes are calculated on the basis of all the material, including coarse fractions.

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 content further increases, 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 3 also gives the results of moisture-density tests for the Fox and Reesville 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 will increase 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, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

samples taken from seven soil profiles

Mechanical analysis ³							Liquid limit	Plasticity index	Classification		
Percentage passing sieve—						Percentage smaller than 0.005 mm.			AASHO ⁴	Unified ⁵	Ohio ⁶
3 in.	¾ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						
			100	98	90	57	44	15	A-7-6(11)	ML	A-7-6
		100	98	96	88	48	51	24	A-7-6(16)	MH-CH	A-7-6
	100	96	94	88	73	37	29	11	A-6(8)	CL	A-6a
	100	98	98	94	77	33	29	5	A-4(8)	ML-CL	A-4a
	100	100	98	95	83	45	42	19	A-7-6(12)	CL	A-7-6
	87	82	78	71	56	29	27	9	A-4(4)	CL	A-4a
			100	99	95	44	33	8	A-4(8)	ML-CL	A-4b
			100	99	96	48	50	24	A-7-6(16)	ML-CL	A-7-6
	100	95	92	83	66	33	26	10	A-4(6)	CL	A-4a
	100	97	96	88	73	25	28	8	A-4(8)	CL	A-4a
	97	91	88	76	60	37	44	21	A-7-6(10)	CL	A-7-6
	63	40	25	9	6	2	NP	NP	A-1-a(0)	GW-GM	A-1-a
			100	99	94	40	39	10	A-4(8)	ML	A-4b
			100	99	96	40	40	17	A-6(11)	CL	A-6b
	100	82	79	71	55	27	26	10	A-4(4)	CL	A-4a
			100	99	96	33	36	7	A-4(8)	ML	A-4b
			100	100	99	43	36	14	A-6(10)	CL	A-6a
			100	99	95	30	27	7	A-4(8)	ML-CL	A-4b
			100	98	92	36	28	5	A-4(8)	ML-CL	A-4b
			100	96	84	43	32	11	A-6(8)	CL	A-6a
	100	92	86	73	51	23	20	4	A-4(3)	ML-CL	A-4a

⁴ Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49 (I). SCS and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification; for example, MH-CH, ML-CL, or GW-GM.

⁵ Based on the Unified Soil Classification System, Tech. Memo. No. 3-357, vol. 1, Waterways Experiment Station, Corps of Engineers, Mar. 1953 (17).

⁶ Based on Classification of Soils, Ohio State Highway Testing Laboratory, Feb. 1, 1955.

⁷ NP=Nonplastic.

Engineering interpretations

Table 4 gives the estimated engineering classifications and physical properties of the soils of the county. For additional information on the soils, refer to the section "Descriptions of the Soils."

The estimated engineering properties in table 4 are based on the engineering test data shown in table 3, on information in other parts of the soil survey, and on experience with the same kinds of soil in other counties.

In table 4 depth to the seasonal high water table refers to the shallowest depth at which the soil is saturated in winter and early in spring because of a perched or other type of water table. If less precipitation than normal falls during the wet season, the water table may be considerably deeper. Soil conditions immediately after heavy precipitation were not considered. In all soils, particularly in those

on sloping areas and uplands, the depth to the water table is generally greater late in spring, in summer, and in fall than is shown in table 4.

Permeability values are estimates of the range in rates of downward movement of water through the major soil horizons when they are saturated but when water drains freely because the horizons are above a true water table. These values are estimates based on soil texture, soil structure, available permeability and infiltration tests, and drainage observations. On a given soil, percolation through the surface layer (topsoil) varies considerably according to land use and management, as well as initial moisture conditions.

The available water capacity, expressed in inches of water per inch of soil depth, is the approximate amount of capillary water in the soil when wet to field capacity.

TABLE 4.—*Estimated*

[Properties of Gravel pits (Gp), Gullied land (GuC, GuD, GuF), Made land and Borrow pits (Mb),

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Seasonal high water table	Bed-rock		USDA texture	Unified	AASHO
	<i>Feet</i>	<i>Feet</i>	<i>Inches</i>			
Birkbeck (BbA)-----	2-3	>5	0-11 11-46 46-59 59-72	Silt loam----- Silty clay loam----- Silt loam----- Loam-----	ML, CL CL ML, CL CL or ML- CL	A-4, A-6 A-6 A-4, A-6 A-4, A-6
Bonpas (Bn. Bo)-----	0-1	>5	0-10 10-54 54-60	Silty clay loam----- Heavy silty clay loam----- Silty clay loam-----	CL, ML CH, CL CL, ML	A-6, A-7 A-7 A-7, A-6
Brookston (BrA, BsA)-----	0-1	>5	0-10 10-27 27-60	Silty clay loam----- Silty clay and silty clay loam----- Loam-----	ML, ML- CL CL or MH- CH CL, ML- CL	A-6, A-7 A-7, A-6 A-6, A-4
Casco (CaE2, CaF2, CaF3)----- (For Rodman and Fox parts of these units, refer to the Rodman and Fox series.)	3+	>5	0-5 5-19 19-60	Clay loam----- Clay loam----- Loamy sand and gravel-----	ML CL SM, GW	A-4 A-6 A-2, A-1
Celina (CbB, CeA, CeB, CeB2, CmC2)----- (For Miami part in mapping unit CmC2, refer to the Miami series.)	2-3	>5	0-7 7-18 18-29 29-60	Silt loam----- Clay----- Clay loam----- Loam-----	ML, ML- CL CL, CH CL, ML- CL CL, ML- CL	A-4, A-6 A-7 A-7, A-6 A-4, A-6
Channahon (CnE2)----- (For Fairmount part, refer to the Fairmount series.)	2+	1-2	0-7 7-18 18-25	Silt loam----- Silty clay----- Limestone bedrock.	ML, CL CH	A-4, A-6 A-7
Corwin (CoA, CoB)-----	1½-3	>5	0-14 14-28 28-60	Silt loam----- Clay loam----- Loam-----	ML, CL CL, ML- CL CL, ML- CL	A-4, A-6 A-6 A-4
Crane (Cr)-----	0-1	>5	0-11 11-32 32-42 42-60	Silt loam----- Silty clay loam and clay loam----- Loam----- Stratified sand and gravel-----	ML, CL CL ML, CL GP, GW, GM, SP, SW, SM	A-4, A-6 A-6 A-4 A-1, A-2
Crosby (CsA, CsB, CtA, CyB)----- (For Celina part in mapping unit CyB, refer to the Celina series.)	0-1	>5	0-10 10-24 24-60	Silt loam----- Silty clay----- Loam-----	ML, CL- ML CH, CL ML-CL	A-4 A-7 A-4, A-6

See footnotes at end of table.

properties of the soils

Quarries (Qu), and Riverwash (Ro) were too variable to be estimated]

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
			<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>			
100	100	85-100	0.63-2.0	0.19	6.1-6.5	Low to moderate	-----	Low.
100	100	90-100	0.63-2.0	.16	6.0-7.3	Moderate	High	Low.
100	100	85-95	0.63-2.0	.18	6.6-7.3	Low to moderate	High	Low.
85-95	80-90	50-70	0.2-0.63	.15	(¹)	Low	Moderate	Low.
100	100	90-100	0.2-0.63	.17	6.1-6.5	Moderate	-----	Low.
100	100	90-100	0.2-0.63	.15	6.6-7.3	High	High	Low.
100	100	90-100	0.63-0.2	.16	(¹)	High	High	Low.
100	100	85-95	0.63-2.0	.19	6.1-6.5	Moderate to high	-----	Low.
100	90-100	85-90	0.2-0.63	.15	6.1-7.3	High	High	Low.
95-100	85-95	65-75	0.2-0.63	.03	(¹)	Low	High	Low.
90-100	90-100	60-70	0.63-2.0	.16	6.6-7.8	Low	-----	Low.
90-100	85-95	65-75	0.63-2.0	.17	6.6-7.8	Moderate	Low	Low.
85-95	65-75	15-25	2.0-6.3	.07	(¹)	Low	Low	Low.
90-100	90-100	70-80	0.63-2.0	.19	5.6-6.5	Low	-----	Low to moderate.
100	90-100	80-85	0.2-0.63	.15	5.6-7.3	High	High	Low to moderate.
100	90-100	70-80	0.2-0.63	.17	5.6-7.3	Moderate to high	High	Low to moderate.
80-90	75-85	50-60	0.2-0.63	.07	(¹)	Low	Moderate	Low.
100	90-100	75-90	0.63-2.0	.19	6.6-7.3	Moderate	-----	Low.
100	90-100	80-95	0.63-2.0	.15	6.6-7.8	High	High	Low.
100	100	75-85	0.63-2.0	.19	5.1-6.5	Low to moderate	-----	Moderate.
100	100	70-80	0.2-0.63	.17	5.6-7.3	Moderate	High	Low to moderate.
85-95	80-90	55-70	0.2-0.63	.07	(¹)	Low	Moderate	Low.
100	90-100	75-85	0.63-2.0	.19	6.6-7.8	Low to moderate	-----	Low.
100	95-100	80-90	0.63-2.0	.16	6.6-7.3	Moderate	High	Low.
85-95	80-90	50-60	0.63-2.0	.15	(¹)	Low	High	Low.
40-60	20-30	0-15	6.3-12+	.03	(¹)	Low	High	Low.
95-100	90-100	80-95	0.63-2.0	.19	5.1-7.3	Low to moderate	-----	Moderate to low.
100	90-100	80-100	0.2-0.63	.15	5.1-6.5	High	High	Moderate to low.
95-100	85-95	60-70	0.2-0.63	.07	7.4-8.4	Low	High	Low.

TABLE 4.—*Estimated properties*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Seasonal high water table	Bed-rock		USDA texture	Unified	AASHO
	<i>Feet</i>	<i>Feet</i>	<i>Inches</i>			
Dana (DaA, DaB)-----	2-3	>5	0-7 7-29 29-40 40-60	Silt loam----- Silty clay loam----- Silty loam----- Loam and sandy loam-----	ML ML, CL ML, CL ML, ML- CL	A-4, A-6 A-6 A-4, A-6 A-4
Fairmount (FaF2)-----	3+	1-2	0-4 4-10 10	Silty clay loam----- Silty clay----- Limestone and shale bedrock.	CL CH, CL	A-6, A-7 A-7
Fincastle (FcA, FcB)-----	0-1	>5	0-11 11-36 36-60	Silt loam----- Silty clay loam----- Loam-----	ML, CL ML, CL ML, ML- CL	A-4, A-6 A-6 A-4
Fox: (FIA, FIB, FIB2, FIC2, FmA, FmB, FmB2, FmC2, FmD2, FsC3, FsD3).	3+	>5	0-8 8-27 27-60	Loam or silt loam----- Clay loam----- Stratified sand and gravel-----	ML, ML- CL CL, ML GW, GM, SW, or SM	A-4 A-6, A-7 A-1
(FgA, FgB, FgB2, FgC2)-----	3+	>5	0-10 10-30 30-60	Gravelly loam----- Clay loam----- Stratified sand and gravel-----	GM, ML, or SM ML, CL GW, GM, SM, or SW	A-4 A-6, A-7 A-1
Hennepin----- (Mapped only with Miami and Fox soils.)	3+	>5	0-4 4-11 11-60	Silt loam----- Clay loam----- Loam-----	ML, ML- CL CL ML, ML- CL	A-4 A-6, A-7 A-4
Kendallville----- (Mapped only with Ockley soils.)	3+	>5	0-9 9-20 20-38 38-48	Silt loam----- Clay loam----- Gravelly sandy clay loam----- Loam-----	ML, ML- CL CL CL, ML- CL	A-4 A-6, A-7 A-2, A-4 A-4, A-6
Landes: (La, Ld)-----	3+	>5	0-32 32-41 41-48	Sandy loam----- Loam----- Loamy sand-----	SM CL, ML SM	A-4, A-2 A-6 A-2
(Lg)-----	3+	>5	0-15 15-18 18-23 23-30	Sandy loam----- Sandy clay loam----- Gravelly loam----- Gravel and sand-----	SM SC, CL GM, SM GW, GM, SW, SM	A-4, A-2 A-4, A-6, A-2 A-2, A-4 A-1
Lewisburg (LsB, LsB2, LtC3)-----	1½-3	>5	0-7 7-16 16-60	Silt loam----- Clay loam----- Loam-----	ML, CL CL ML, CL	A-4, A-7 A-6, A-7 A-4, A-6

See footnotes at end of table.

of the 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
			<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>			
100	100	85-100	0.63-2.0	0.19	5.6-6.0	Low to moderate	-----	Moderate.
100	100	90-100	0.63-2.0	.16	6.1-7.3	Moderate	High	Low.
100	100	80-90	0.63-2.0	.18	6.6-7.3	Moderate	High	Low.
90-95	85-90	55-65	0.2 -0.63	.07	(¹)	Low	Moderate	Low.
85-100	80-95	60-100	0.63-2.0	.17	(¹)	High	-----	Low.
85-100	80-95	65-100	0.2 -0.63	.15	(¹)	High	High to moderate	Low.
100	90-100	90-100	0.63-2.0	.19	5.1-7.3	Low	-----	Low.
100	95-100	90-100	0.2 -0.63	.16	6.5-7.3	Moderate	High	Low.
95-100	85-90	50-60	0.2 -0.63	.07	(¹)	Low	High	Low.
85-100	85-100	60-80	0.63-2.0	.16	6.1-6.5	Low	-----	Low.
90-100	80-95	50-70	0.63-2.0	.17	5.6-7.8	Moderate to high	Moderate	Low to moderate.
40-60	20-40	0-15	6.3 -12+	.03	(¹)	Low	Very low	Low.
65-85	55-70	40-55	0.63-6.3	.12	6.0-6.5	Low	-----	Low.
90-100	80-95	55-65	0.63-2.0	.16	5.6-7.5	Moderate to high	Moderate	Low to moderate.
40-60	20-30	0-15	6.3 -12+	.03	(¹)	Low	Very low	Low.
95-100	90-100	70-80	0.63-2.0	.19	6.1-7.3	Low	-----	Low to moderate.
90-100	90-100	65-70	0.63-2.0	.17	6.0-7.5	Moderate	Moderate	Low.
75-95	70-90	50-65	0.2 -0.63	.07	7.4-8.4	Low	Low	Low.
90-100	90-100	65-80	0.63-2.0	.19	5.6-7.3	Low to moderate	-----	Low to moderate.
85-100	80-100	55-70	0.63-2.0	.17	5.6-6.5	Moderate	Moderate	Low to moderate.
70-85	60-75	30-40	0.63-2.0	.16	5.6-6.5	Moderate	Moderate	Low to moderate.
75-95	70-90	50-65	0.2 -0.63	.07	(¹)	Low	Low	Low.
85-100	80-95	25-50	2.0 -6.3	.11	6.6-7.3	Low	-----	Low.
85-90	80-85	50-65	2.0 -6.3	.16	6.6-7.3	Low	Moderate	Low.
85-100	80-100	15-35	6.3 -12+	.04	(¹)	Low	Low	Low.
85-100	80-95	25-50	2.0 -6.3	.11	6.6-7.3	Low	-----	Low.
85-95	80-95	20-55	2.0 -6.3	.16	6.6-7.3	Low	Moderate	Low.
65-85	55-75	35-45	6.3 -12+	.10	(¹)	Low	Low	Low.
40-65	20-40	0-15	6.3 -12+	.05	(¹)	Low	Low	Low.
90-100	90-100	70-80	0.63-2.0	.19	6.1-7.3	Low to moderate	-----	Low.
100	90-100	70-80	0.2 -0.63	.17	(¹)	Moderate to high	High	Low.
80-90	75-85	55-70	0.2 -0.63	.07	(¹)	Low	High	Low.

TABLE 4.—Estimated properties

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Seasonal high water table	Bed-rock		USDA texture	Unified	AASHO
	<i>Feet</i>	<i>Feet</i>	<i>Inches</i>			
Medway (Md)-----	2-3	>5	0-13 13-27 27-48 48	Silt loam----- Loam and sandy clay loam----- Sandy loam----- Sand and gravel.	ML or CL CL or ML SM	A-4, A-6 A-4, A-6 A-4
Miami (MeC2, MIC, MIC2, MID, MID2, MmC3, MmD3, MnB, MnB2, MoB, MoB2, MpB3, MrE2, MrE3, MrF2, MrF3). (For Celina part in mapping units MnB, MnB2, MoB, MoB2, MpB3 and for Fox and Hennepin parts in mapping units MrE2, MrE3, MrF2, MrF3, refer to the respective series.)	3+	>5	0-7 7-26 26-60	Silt loam----- Clay loam----- Loam-----	ML-CL, ML CL, CH ML-CL, CL	A-4 A-7, A-6 A-4, A-6
Millsdale (MsA, MtA)-----	0-1	1½-3½	0-6 6-21 21-36 36-45	Silt loam or silty clay loam----- Silty clay----- Loam----- Limestone bedrock.	CL MH, CH ML, CL	A-6, A-7 A-7 A-4, A-6
Milton (MuA, MuB, MuB2, MuC2, MvC3) --	3+	1½-3½	0-10 10-31 31-40	Silt loam----- Clay loam----- Limestone bedrock.	ML, ML- CL CL	A-4 A-6, A-7, A-4
Ockley (OcA, OcB, OkA, OkB, OkB2, OkC2, OkD2, OIC3, OID3). (For Kendallville part in mapping units OkA, OkB, OkB2, OkC2, OkD2, OIC3, and OID3, refer to the Kendallville series.)	3+	>5	0-36 36-50 50-60	Silt loam----- Sandy clay and sandy clay loam----- Stratified sand and gravel-----	ML, CL CL, SC SW, SM, GW, GM	A-4, A-6 A-6, A-4 A-1
Odell (OsB)-----	0-1	>5	0-7 7-36 36-60	Silt loam----- Clay loam----- Silty clay loam-----	ML, CL CL, CH ML, CL	A-4, A-6 A-6, A-7 A-4, A-6
Plattville (PIB)-----	4+	2-4	0-10 10-18 18-40 40-50	Silt loam----- Silty clay loam----- Clay loam----- Limestone bedrock.	ML, CL CL CL	A-4, A-6 A-7, A-6 A-7, A-6
Pyrmont (PyA, PyB)-----	0-1	>5	0-10 10-16 16-60	Silt loam----- Clay loam----- Loam-----	ML, CL CL ML-CL, CL	A-4, A-6 A-6, A-7 A-4
Ragsdale (Ra)-----	0-1	>5	0-4 4-46 46-51 51-60	Silt loam----- Silty clay loam----- Silt loam----- Loam-----	ML, CL CL ML, CL ML, CL	A-4, A-6 A-6, A-7 A-4, A-6 A-4
Randolph (RcA, RcB)-----	0-1	1½-3½	0-10 10-24 24-36 36-45	Silt loam----- Clay loam, silty clay loam, and silty clay. Loam----- Limestone bedrock.	ML, CL CL or CH CL or ML	A-4, A-6 A-7, A-6 A-4, A-6
Raub (RdA)----- (For Dana part, refer to the Dana series.)	0-1	>5	0-12 12-36 36-60	Silt loam----- Silty clay loam----- Loam-----	ML ML, CL ML, ML- CL	A-4, A-6 A-7, A-6 A-4, A-6

See footnotes at end of table.

of the 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
90-100	90-100	70-85	0.63-2.0	Inches per hour 0.18	pH 5.6-7.3	Low	-----	Moderate to low.
100	90-95	50-65	0.63-2.0	.17	6.1-7.3	Low to moderate	-----	Low.
95-100	80-85	35-45	2.0-6.3	.15	7.4-8.4	Low	-----	Low.
95-100	90-100	70-80	0.63-2.0	.19	5.1-6.6	Low to moderate	-----	Moderate.
90-100	90-100	75-85	0.2-0.63	.17	4.5-6.1	Moderate	-----	Moderate to high.
75-95	70-90	50-65	0.2-0.63	.07	7.4-8.4	Low	-----	Low.
100	100	85-100	0.63-2.0	.17	6.1-7.3	Moderate to high	-----	Low.
100	100	85-95	0.2-0.63	.15	6.6-7.3	High	-----	Low.
90-95	85-90	65-80	0.2-0.63	.15	7.4-8.4	Low	-----	Low.
100	100	80-90	0.63-2.0	.19	5.1-6.5	Low	-----	Moderate
90-100	75-85	55-70	0.2-0.63	.17	7.4-8.4	Moderate to high	-----	Low.
100	90-100	75-95	0.63-2.0	.18	5.1-6.5	Low to moderate	-----	Moderate to low.
85-100	80-100	40-75	0.63-2.0	.16	5.6-6.5	Moderate	-----	Low to moderate.
40-60	25-30	4-15	6.3-12+	.03	(¹)	Low	-----	Low.
100	100	89-90	0.63-2.0	.19	5.6-7.3	Low to moderate	-----	Moderate to low.
100	100	80-90	0.2-0.63	.17	6.6-7.3	Moderate to high	-----	Low.
85-95	80-90	65-75	0.2-0.63	.07	(¹)	Low	-----	Low.
100	100	90-95	0.63-2.0	.19	6.1-7.3	Low	-----	Low.
100	100	95-100	0.2-0.63	.16	6.5-7.4	High	-----	Low.
100	100	80-85	0.2-0.63	.17	² 6.6	High	-----	Low.
100	90-100	70-85	0.2-0.63	.19	5.6-6.5	Low	-----	Moderate.
100	85-100	60-85	0.2-0.63	.17	6.1-7.3	Moderate	-----	Low.
85-95	89-90	55-70	0.2-0.63	.07	7.4-8.4	Low to moderate	-----	Low.
100	90-100	85-100	0.63-2.0	.19	5.6-6.0	Low to moderate	-----	Moderate.
100	90-100	90-100	0.2-0.63	.16	6.1-7.3	Moderate	-----	Low.
100	90-100	80-95	0.2-0.63	.18	7.4-8.4	Low to moderate	-----	Low.
80-85	75-80	55-70	0.2-0.63	.15	7.4-8.4	Low	-----	Low.
100	100	85-90	0.63-2.0	.19	5.6-6.5	Moderate	-----	Moderate.
100	100	75-85	0.2-0.63	.17	5.1-6.5	High	-----	Moderate to low.
100	85-95	65-80	0.2-0.63	.15	7.4-8.4	Low	-----	Low.
100	100	85-100	0.63-2.0	.19	5.6-6.0	Low	-----	Moderate.
100	100	90-100	0.2-0.63	.16	6.1-6.5	Moderate	-----	Low.
90-95	85-90	55-65	0.2-0.63	.07	² 7.0	Low	-----	Low.

TABLE 4.—*Estimated properties*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Seasonal high water table	Bed-rock		USDA texture	Unified	AASHO
	<i>Feet</i>	<i>Feet</i>	<i>Inches</i>			
Reesville (ReA)-----	0-1	>5	0-8 8-30 30-60	Silt loam----- Silty clay loam----- Silt loam-----	ML, CL CL ML, CL	A-4, A-7, A-6 A-4, A-6
Ritchey (RhB2, RhC2, RhD2, RnC3, RnD3). (For Channahon part, refer to the Channahon series.)	3+	1-1½	0-14 14-17 17-25	Silt loam to clay loam----- Clay----- Limestone bedrock.	ML, CL CH	A-4, A-6 A-7
Rodman----- (Mapped only with Casco and Fox soils.)	3+	>5	0-16 16-60	Sandy loam----- Gravelly sand and gravel-----	SM GW, GM, SW, or SM	A-2, A-4 A-1
Ross (Rs)-----	3+	>5	0-22 22-46 46-72	Loam----- Clay loam----- Sandy loam-----	ML, CL CL, ML- CL SM	A-4, A-6 A-4, A-6 A-4, A-2
Russell (RuA, RuB, RuB2, RuC2, RuD2, RvC3, RvD3).	3+	>5	0-8 8-39 39-60	Silt loam----- Silty clay loam----- Loam and clay loam-----	ML, ML- CL CL, ML- CL ML, CL	A-4 A-6 A-4
Shoals (Sh)-----	0-1	>5	0-14 14-45 45-60	Silt loam----- Loam----- Sand and gravel-----	ML, CL ML, CL GM, SM	A-4, A-6 A-4 A-1, A-2
Sleeth (S1A)-----	0-1	>5	0-12 12-21 21-50 50-60	Silt loam----- Silty clay loam----- Sandy clay loam----- Stratified sand and gravel-----	ML, CL CL SC, CL GP, GW, GM, SP, SW, SM	A-4, A-6 A-7, A-6 A-4, A-6 A-1, A-2
Sloan (So)-----	0-1	>5	0-12 12-46 46-60	Silt loam----- Clay loam----- Gravelly loam-----	ML, CL CL ML, SM	A-4 A-7, A-6 A-4
Thackery (Tha, ThB)-----	2-3	>5	0-17 17-31 31-48 48-60	Silt loam----- Silty clay loam----- Sandy clay loam----- Stratified sand and gravel-----	ML, CL CL SC, CL GP, GW, GM, SP, SW, SM	A-4, A-6 A-7, A-6 A-4, A-6 A-1, A-2
Tippecanoe (TpA, TpB)-----	2-3	>5	0-6 6-37 37-42 42-60	Silt loam----- Silty clay loam and clay loam----- Sandy clay loam----- Stratified sand and gravel-----	ML, CL CL SM GP, GW, SM, SP, SW, SM	A-4 A-6 A-4, A-2 A-2, A-1

See footnotes at end of table.

of the 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
			<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>			
100	90-100	85-100	0.63-2.0	0.19	5.6-6.5	Low-----	-----	Moderate.
100	90-100	90-100	0.2 -0.63	.16	6.1-7.0	Moderate-----	High-----	Low.
100	90-100	80-95	0.2 -0.63	.18	7.0-8.4	Low to moderate-----	High-----	Low.
100	90-100	80-90	0.63-2.0	.19	6.1-6.5	Moderate-----	-----	Low.
100	90-100	85-95	0.2 -0.63	.15	5.6-7.3	High-----	Moderate-----	Low to moderate.
80-95	80-90	25-40	2.0 -6.3	.11	6.6-7.6	Low-----	Low-----	Low.
50-80	40-70	5-10	6.3 -12+	.04	(¹)	Low-----	Low-----	Low.
95-100	85-100	60-75	0.63-2.0	.19	² 7.3	Low-----	-----	Low.
90-100	80-100	70-85	0.63-2.0	.17	² 6.6	Moderate to low-----	Moderate-----	Low.
90-100	85-95	30-40	2.0 -6.3	.10	² 6.6	Low-----	Low-----	Low.
100	90-100	90-95	0.63-2.0	.19	5.6-6.0	Low-----	-----	Moderate.
100	95-100	80-90	0.20-0.63	.16	4.5-5.5	Moderate-----	Moderate-----	Moderate to high.
90-95	85-90	50-60	0.2 -0.63	.07	(¹)	Low-----	Low-----	Low.
100	100	80-85	0.63-2.0	.19	6.8-7.8	Low to moderate-----	-----	Low.
85-95	80-90	50-60	0.2 -0.63	.17	6.8-7.8	Low-----	High-----	Low.
85-100	75-85	12-25	2.0 -6.3+	.04	6.6-7.8	Low-----	High-----	Low.
100	90-100	65-80	0.63-2.0	.19	5.1-6.8	Low-----	-----	Moderate to low.
100	90-100	80-90	0.2 -0.63	.16	5.1-6.5	Moderate-----	High-----	Moderate to low.
100	85-95	40-55	0.2 -0.63	.16	6.1-7.3	Moderate-----	High-----	Low.
40-60	25-40	4-15	6.3 -12+	.03	7.4-8.4	Low-----	High-----	Low.
100	95-100	75-80	0.63-2.0	.19	6.6-7.3	Low to moderate-----	-----	Low.
100	100	65-75	0.2 -2.0	.17	² 7.2	Moderate-----	High-----	Low.
80-85	75-80	45-55	0.63-2.0	.10	(¹)	Low-----	High-----	Low.
100	90-100	65-80	0.63-2.0	.19	5.6-6.0	Low-----	-----	Low.
100	90-100	80-90	0.63-2.0	.16	5.6-6.5	Moderate-----	High-----	Low to moderate.
100	85-95	40-55	0.63-2.0	.16	² 6.6	Moderate-----	High-----	Low.
40-60	25-40	4-15	6.3 -12+	.03	(¹)	Low-----	Moderate-----	Low.
100	90-100	75-80	0.63-2.0	.19	5.1-7.3	Low-----	-----	Low to moderate.
100	90-95	80-90	0.63-2.0	.17	6.6-7.8	Moderate-----	High-----	Low to moderate.
90-100	80-90	25-45	0.63-2.0	.07	(¹)	Low-----	High-----	Low.
40-60	25-40	0-15	6.3 -12+	.03	(¹)	Low-----	Moderate-----	Low.

TABLE 4.—Estimated properties

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Sea-sonal high water table	Bed-rock		USDA texture	Unified	AASHO
	<i>Feet</i>	<i>Feet</i>	<i>Inches</i>			
Warsaw (WaA)-----	3+	>5	0-13 13-27 27-35 35-60	Silt loam----- Clay loam----- Clay----- Stratified gravel and sand-----	ML, CL CL CH, CL GP, GW, GM, SP, SW, SM	A-4 A-7, A-6 A-7, A-6 A-1, A-2
Wea (WeA)-----	3+	>5	0-14 14-33 33-52 52-60	Silt loam or silty clay loam----- Clay loam----- Sandy clay loam----- Stratified sand and gravel-----	ML, CL CL CL, SC GP, GM, SM	A-4 A-6 A-6, A-4 A-1, A-2
Westland (Wn, Ws)-----	0-1	>5	0-12 12-31 31-50 50-60	Silt loam----- Clay loam----- Gravelly loam----- Stratified sand and gravel-----	ML, CL CL ML, CL GM, GW, SM, or SW	A-4, A-6 A-7, A-6 A-4 A-1
Wynn (WyB, WyB2, WyC2)-----	1½-3+	1½-3	0-7 7-28 28-40	Silt loam----- Silty clay loam----- Limestone bedrock.	ML, CL CL	A-4, A-6 A-7, A-6
Xenia (XeA, XeB, XeB2)-----	1½-2½	>5	0-14 14-41 41-60	Silt loam----- Silty clay loam and silt loam----- Loam-----	ML, ML- CL ML	A-4 A-7, A-6 A-4

¹ Calcareous.

When the soil is air dry, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation. Available water capacity refers to the maximum amount of moisture a particular soil can store for use by plants. The estimated values listed are based on the difference in the percentage of moisture retained at ½ and 15 atmospheres of tension for medium- and fine-textured soils. For sandy soils, the estimated values are based on the difference between 1/10 and 15 atmospheres of tension.

The estimated shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Those soil materials rated *high* are normally undesirable for some engineering uses since the increase in volume when the dry soil is wet is generally accompanied by a loss in bearing capacity.

Table 5 interprets the soils of Preble County for various engineering uses. This information is based on the engineering test data for selected soils in table 3, on mechanical analyses of other soils in the county, and on field experi-

ence. For additional information on the soils, refer to the section "Descriptions of the Soils."

A brief explanation of some of the interpretations given in the various columns of table 5 follows.

Suitability for winter grading.—Because of wetness, plasticity, or susceptibility to frost action, many of the soils are not suited to grading during part of the winter. Such soils are rated *poor* or *very poor*.

Susceptibility to frost action.—Silty and clayey soils that are wet most of the winter because of slow internal drainage or surface runoff are most susceptible to frost action.

Suitability for road fill.—Well-graded, coarse-grained material or mixtures of clay and coarse-grained material are very desirable for road fill. Highly plastic clayey soils, poorly graded silty soils, and organic soils are difficult to compact and are low in stability; consequently, they are undesirable for road fill.

of the 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
			<i>Inches per hour</i>	<i>Inches per inch of soil</i>	<i>pH</i>			
100	80-100	60-75	0.63-2.0	0.19	7.4-7.8	Low to moderate	-----	Low.
100	90-100	70-80	0.63-2.0	.17	6.6-7.3	Moderate	Moderate	Low.
90-95	85-90	70-90	0.63-2.0	.15	6.6-7.3	Moderate to high	Moderate	Low.
40-60	20-30	4-15	6.3-12+	.03	(¹)	Low	Low	Low.
100	90-100	70-80	0.63-2.0	.19	6.6-7.8	Low to moderate	-----	Low to moderate.
100	90-100	75-85	0.63-2.0	.17	6.6-7.3	Moderate	Moderate	Low.
95-100	90-95	45-55	0.63-2.0	.16	6.6-7.3	Moderate	Moderate	Low.
40-60	25-40	0-15	6.3-12+	.03	(¹)	Low	Low	Low.
100	90-100	70-85	0.63-2.0	.19	6.0-7.4	Low to Moderate	-----	Low.
100	90-100	65-75	0.63-2.0	.17	6.6-7.4	Moderate	High	Low.
70-80	70-80	50-65	0.63-2.0	.15	7.3-7.8	Low	High	Low.
40-60	25-40	4-15	6.3-12+	.07	(¹)	Low	High	Low.
100	90-100	80-95	0.63-2.0	.19	5.1-5.5	Moderate	-----	Moderate.
100	90-100	85-95	0.2-0.63	.16	5.0-6.5	Moderate	Moderate	Moderate to low.
100	90-100	90-100	0.63-2.0	.19	5.1-6.0	Low	-----	Moderate.
100	95-100	85-95	0.2-0.63	.16	4.5-5.0	Moderate	High	High.
90-95	85-90	50-60	0.2-0.63	.07	(¹)	Low	Moderate	Low to moderate.

² Ranges to calcareous.

Suitability as source of topsoil.—The thickness, texture, and inherent fertility of the surface layer of a soil determine its suitability for use as a topdressing to promote the growth of vegetation.

Described next are soil features that affect use of the soils for specific engineering purposes.

Highway locations.—Features that affect highway location include depth to bedrock, depth to the water table, steepness of slopes, tendency of soil to slip, and the hazard of flooding.

Farm ponds.—Under the subheading "Reservoir area," consideration is given primarily to the sealing potential of the reservoir. Also considered are depth to bedrock and the susceptibility to overflow on flood plains. Under the subheading "Embankment," the soils are rated according to the stability and permeability of the soil material when used in the construction of pond embankments. The rates of permeability given in this column are for the soil material

when compacted at optimum moisture content. The information in this column also pertains to dikes and levees.

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

Irrigation.—The relative ease with which water normally infiltrates into, percolates through, and drains from each of the soils and the available moisture holding capacity of the soils are important features.

Terraces and diversions.—Slope and erosion are the main soil features that affect terraces and diversions. Other important features are depth to bedrock and the presence of a seasonal water table. Nearly level soils need no terracing; steep soils are not well suited to terracing. Highly erodible soils require special care in the construction of diversions.

Waterways.—Slope and erosion are the main features that affect waterways. Depth to bedrock and depth to the water table are given where applicable.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of—			
			Topsoil	Sand and gravel	Road fill	
					Solum	Substratum
Birkbeck (BbA)-----	Poor-----	Moderate-----	Good-----	Not suitable-----	Fair-----	Fair-----
Bonpas (Bn, Bo)-----	Poor-----	High-----	Good-----	Not suitable-----	Poor; wet soil.	Poor; wet soil.
Brookston (BrA, BsA) ¹ -----	Poor-----	High-----	Good-----	Not suitable-----	Poor; wet soil.	Poor; wet soil.
Casco (CaE2, CaF2, CaF3)----- (Casco part only; for properties of the Rodman and Fox soils, see the Rodman and Fox series.)	Good-----	Low-----	Fair-----	Good below depth of 2 feet.	Fair-----	Good-----
Celina (CbB, CeA, CeB, CeB2, CmC2). ¹ ----- (Celina part of CmC2 only; for properties of the Miami soil, see the Miami series.)	Poor-----	Moderate to high.	Fair-----	Not suitable-----	Fair to poor.	Fair-----
Channahon (CnE2)----- (Channahon part only; for properties of the Fairmount soils, see the Fairmount series.)	Poor-----	Low-----	Poor-----	Not suitable-----	Poor-----	Unsuitable; shallow to bedrock.
Corwin (CoA, CoB)-----	Poor-----	Moderate to high.	Good-----	Not suitable-----	Fair-----	Fair-----
Crane (Cr)-----	Poor-----	High-----	Good-----	Good below depth of 3 feet; well graded and stratified.	Fair-----	Good-----
Crosby (CsA, CsB, CtA, CyB) ¹ ----- (Crosby part only of CyB; for properties of the Celina soil, see the Celina series.)	Poor-----	High-----	Fair-----	Not suitable-----	Poor-----	Fair-----
Dana (DaA, DaB)-----	Poor-----	Moderate to high.	Good-----	Not suitable-----	Fair-----	Fair-----

See footnotes at end of table.

engineering properties of the soils

Soil features affecting suitability for engineering practices for—						
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir area	Embankment				
Nearly level-----	Slow rate of seepage.	Fair compaction; fair stability.	Seasonal high water table in some places; moderately slowly permeable till material.	Moderately to moderately slowly permeable to a depth of about 5 feet.	No adverse features.	Erodible.
Seasonal high water table; moderately slow permeability; soft material.	Very slow rate of seepage.	Fair stability; poor compaction; slow permeability.	Seasonal high water table; moderately slow permeability.	Good infiltration; seasonal high water table; moderately slow permeability; moderately fine textured surface layer.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Seasonal high water table; clayey soil; moderately slow permeability.	Slow rate of seepage.	Fair stability; fair to poor compaction; slow permeability.	Poor natural drainage; moderately slow permeability.	Good infiltration; moderately fine textured surface layer in places; seasonal high water table.	Seasonal high water table; nearly level.	Nearly level; high water table.
Steepness-----	Excessive rate of seepage in substratum.	Adequate strength and stability; permeable.	Well drained-----	Rapid infiltration; low water-holding capacity.	Steepness; erodible.	Steepness; erodible.
Moderately slow permeability; some bouldery areas.	Slow rate of seepage; bouldery in some places.	Fair stability; moderately slow permeability; fair compaction.	Moderately slow permeability; seasonal high water table in some places.	Moderately slow permeability; seasonal high water table in some places.	Erodible-----	Erodible.
Bedrock at depths of 1 to 2 feet.	Bedrock at depths of 1 to 2 feet may be fractured.	Fair stability; slow permeability.	Well drained-----	Strongly sloping-----	Strongly sloping; bedrock at depth of 1 to 2 feet.	Erodible; bedrock at depths of 1 to 2 feet.
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Fair stability; moderately slow permeability; fair compaction.	Moderately slow permeability; seasonal high water table in some places.	Good water-holding capacity; moderately slow permeability.	No adverse features.	Nearly level or gently sloping.
Seasonal high water table; moderate permeability.	Excessive rate of seepage in substratum.	Good stability; permeable; good compaction; fair to good resistance to piping.	Seasonal high water table; moderately slow permeability.	Adequate infiltration and water-holding capacity; high water table.	Nearly level; seasonal high water table.	Seasonal high water table; nearly level.
Seasonal high water table; clayey subsoil; moderately slow permeability; some bouldery areas.	Slow rate of seepage; some bouldery areas.	Good stability; slow permeability; fair compaction; some bouldery areas.	Moderately slow permeability; seasonal high water table.	Moderately slow infiltration and permeability; seasonal high water table.	Nearly level to gently sloping; erodible; some bouldery areas.	Seasonal high water table; some bouldery areas.
Seasonal high water table.	Slow rate of seepage.	Good stability; slow permeability.	Seasonal high water table in some places; moderately slow permeability.	Moderate infiltration; seasonal high water table.	Nearly level to gently sloping; erodible.	Erodible.

TABLE 5.—*Interpretations of 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	Substratum
Fairmount (FaF2)-----	Poor-----	Moderate-----	Poor-----	Not suitable-----	Poor-----	Unsuitable; shallowness to bed-rock.
Finecastle (FcA, FcB)-----	Poor-----	High-----	Fair to good.	Not suitable-----	Fair to poor.	Fair-----
Fox (FgA, FgB, FgB2, FgC2, FIA, FIB, FIB2, FIC2, FmA, FmB, FmB2, FmC2, FmD2, FsC3, FsD3.)	Fair; good below a depth of about 27 inches.	Low-----	Fair-----	Good; well graded and stratified.	Fair-----	Good-----
Gravel pits (Gp) ² -----						
Gullied land (GuC, GuD, GuF)-----	Poor-----	Moderate to high.	Not suitable.	Not suitable-----	Fair to poor.	Fair-----
Hennepin----- (Mapped only in undifferentiated units with Miami and Fox soils.)	Poor-----	Moderate-----	Poor-----	Not suitable-----	Fair-----	Fair-----
Kendallville----- (Mapped only in undifferentiated units with Ockley soils.)	Poor-----	Moderate-----	Fair-----	Not suitable-----	Fair-----	Fair-----
Landes (La, Ld, Lg)-----	Fair-----	Low-----	Good (La is poor.)	Fair; well graded and stratified.	Good-----	Good-----
Lewisburg (LsB, LsB2, LtC3)-----	Poor-----	High-----	Poor-----	Not suitable-----	Fair to poor.	Fair-----
Madeland and Borrow pits (Mb) ² -----						
Medway (Md)-----	Poor-----	Moderate to high.	Good-----	Fair for sand in major stream valleys; poor along tributary valleys.	Fair-----	Fair-----
Miami (MeC2, MIC, MIC2, MID, MID2, MmC3, MmD3, MnB, MnB2, MoB, MoB2, MpB3, MrE2, MrE3, MrF2, MrF3.) ¹ (Miami part only; for properties of the Celina soils in MnB, MnB2, MoB, MoB2, and MpB3, see the Celina series, and for properties of the Fox and Hennepin soils in MrE2, MrE3, MrF2, and MrF3, see the Fox and Hennepin series.)	Poor-----	Moderate-----	Fair-----	Not suitable-----	Fair to poor.	Fair-----

See footnotes at end of table.

properties of the soils—Continued

Soil features affecting suitability for engineering practices for—						
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir area	Embankment				
Bedrock at depths of 1 to 2 feet; steepness.	Bedrock at depths of 1 to 2 feet.	Limited amount of soil material; fair to poor compaction.	Well drained.....	Very steep; not normally irrigated.	Very steep; erodible; bedrock at depths of 1 to 2 feet.	Very steep; erodible.
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Good stability; moderately slow permeability; good compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Nearly level to gently sloping; erodible.	Erodible.
Gravelly material in cuts.	Excessive rate of seepage.	Adequate strength and stability; permeable.	Well drained.....	Good infiltration; medium to low water-holding capacity.	Nearly level to strongly sloping; moderate permeability.	Nearly level to strongly sloping; erodible.
Erosion hazard on slopes.	Slow rate of seepage.	Stable; slow permeability.	Well drained.....	Low fertility; moderate infiltration.	Erodible.....	Erodible.
Steep slopes.....	Slow rate of seepage.	Fair stability; slow permeability; fair compaction.	Well drained.....	Steep.....	Steep; moderate permeability.	Erodible.
No limiting features.	Generally slow rate of seepage; rapidly permeable material in a few areas.	Fair stability; slow permeability; fair compaction.	Well drained.....	Moderate infiltration; good water-holding capacity.	Gently to strongly sloping; erodible.	Erodible.
Subject to flooding.	Subject to flooding; permeable layers.	Fair stability; permeable; good compaction.	Well drained.....	Low to medium water-holding capacity; subject to flooding.	Nearly level; subject to flooding.	Subject to flooding.
Moderately slow permeability.	Slow rate of seepage.	Fair stability; slow permeability; fair compaction.	Seasonal high water table in some places; moderately slow permeability.	Moderately slow permeability.	Nearly level to sloping.	Erodible.
Seasonal high water table; subject to flooding.	Subject to flooding; slow rate of seepage.	Fair stability; slow permeability; good compaction.	Moderate permeability; seasonal high water table; subject to flooding.	Moderate permeability; high water-holding capacity.	Nearly level; subject to flooding.	Erodible; subject to flooding.
Moderately slow permeability; boulders in a few places.	Slow rate of seepage.	Fair stability; slow permeability; fair compaction.	Well drained.....	Moderate water-holding capacity; moderately slow permeability.	Gently to strongly sloping.	Erodible.

TABLE 5.—*Interpretations of 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	Substratum
Millsdale (MsA, MtA)-----	Poor-----	High-----	Good-----	Not suitable-----	Not suitable or poor.	Unsuitable; shallow to bedrock.
Milton (MuA, MuB, MuB2, MuC2, MvC3).	Poor-----	Moderate-----	Fair-----	Not suitable-----	Poor-----	Unsuitable; shallow to bedrock.
Oekley (OcA, OcB, OkA, OkB, OkB2, OkC2, OkD2, OIC3, OID3). (Oekley part only; for properties of the Kendallville soils in OkA, OkB, OkB2, OkC2, OkD2, OIC3, and OID3, see the Kendallville series.)	Fair; good below a depth of about 50 inches.	Moderate-----	Good-----	Good for gravel, good for sand; well graded and stratified (Oekley part of Oekley and Kendallville soils unsuitable for sand and gravel).	Fair-----	Good-----
Odell (OsB)-----	Poor-----	Good-----	Fair-----	Not suitable-----	Poor-----	Fair-----
Plattville (PlB)-----	Poor-----	Moderate-----	Good-----	Not suitable-----	Poor-----	Unsuitable; shallow to bedrock.
Pyrmont (PyA, PyB)-----	Poor-----	High-----	Fair-----	Not suitable-----	Poor-----	Fair; wet soil.
Quarries (Qu) ² -----						
Ragsdale (Ra)-----	Poor-----	High-----	Good-----	Not suitable-----	Poor-----	Poor; wet soil.
Randolph (RcA, RcB)-----	Poor-----	High-----	Fair-----	Not suitable-----	Poor-----	Poor; bedrock at depths of 1½ to 3½ feet.

See footnotes at end of table.

properties of the soils—Continued

Soil features affecting suitability for engineering practices for—						
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir area	Embankment				
Bedrock at depths of 1½ to 4 feet; seasonal high water table; clayey material.	Bedrock at depths of 1½ to 4 feet; some areas have high seepage rate.	Limited amount of soil material; poor stability; poor compaction.	Seasonal high water table; moderately slow permeability.	Moderately slow permeability; seasonal high water table.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Bedrock at depths of 1½ to 3½ feet.	Bedrock at depths to 1½ to 3½ feet; some areas have high seepage rate.	Bedrock at depths of 1½ to 3½ feet; fair stability; slow permeability; fair compaction.	Well drained-----	Moderately slow permeability; moderate to low water-holding capacity.	Nearly level to sloping; erodible.	Erodible.
No limiting features.	Excessive rate of seepage in substratum.	Fair stability; slow permeability; fair compaction.	Well drained-----	High water-holding capacity; moderate permeability.	No adverse features.	Erodible.
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Fair stability; slow permeability; fair compaction.	Seasonal high water table; moderately slow permeability.	Moderately slow permeability; seasonal high water table; high water-holding capacity.	Gently sloping; erodible.	Erodible.
Bedrock at depths of 2 to 4 feet.	Bedrock at depths of 2 to 4 feet and fractured in some places.	Fair stability; slow permeability; fair compaction.	Well drained-----	Good infiltration; medium water-holding capacity.	Nearly level to gently sloping; erodible.	Erodible.
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Fair stability; slow permeability; fair compaction.	Seasonal high water table; moderately slow permeability; compact till at depths of 1 to 1½ feet.	Moderately slow permeability; high water table.	Nearly level to gently sloping; high water table.	Erodible; high water table.
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Fair stability; slow permeability; good 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.
Seasonal high water table; moderately slow permeability; bedrock at depths of 1½ to 3½ feet.	Bedrock at depths of 1½ to 3½ feet.	Good stability; slow permeability; good to fair compaction.	Seasonal high water table; moderately slow permeability; bedrock at depths of 1½ to 3½ feet.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; nearly level to gently sloping; bedrock at depths of 1½ to 3½ feet.	Erodible; bedrock at depths of 1½ to 3½ feet.

TABLE 5.—*Interpretations of 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	Substratum
Raub (RdA)----- (Raub part only; for properties of the Dana soils, see the Dana series.)	Poor-----	High-----	Good-----	Not suitable-----	Fair to poor-----	Fair-----
Reesville (ReA)-----	Poor-----	High-----	Good-----	Not suitable-----	Fair-----	Fair-----
Ritchey (RhB2, RhC2, RhD2, RnC3, RnD3). (Ritchey part only; for properties of the Channahon soils, see the Channahon series.)	Poor-----	Moderate-----	Poor-----	Not suitable-----	Poor-----	Unsuitable; shallow to bedrock.
Riverwash (Ro) ² -----						
Rodman----- (Mapped only in undifferentiated units with Casco and Fox soils.)	Good-----	Low-----	Poor-----	Good-----	Good-----	Good-----
Ross (Rs)-----	Poor-----	Moderate-----	Good-----	Good for sand in major stream valleys; poor along tributary valleys.	Fair-----	Fair to good-----
Russell (RuA, RuB, RuB2, RuC2, RuD2, RvC3, RvD3).	Poor-----	Moderate-----	Good-----	Not suitable-----	Fair to poor-----	Fair-----
Shoals (Sh)-----	Poor-----	High-----	Good-----	Not suitable-----	Poor-----	Poor; wet soil.
Sleeth (SIA)-----	Poor-----	High-----	Good-----	Good; well graded and stratified.	Fair-----	Good-----
Sloan (So)-----	Poor-----	High-----	Good-----	Not suitable-----	Poor; wet soil.	Poor; wet soil.
Thackery (ThA, ThB)-----	Poor-----	Moderate to high.	Good-----	Good; well graded and stratified.	Fair-----	Good-----

See footnotes at end of table.

properties of the soils—Continued

Soil features affecting suitability for engineering practices for—						
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir area	Embankment				
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Good stability; slow permeability; good compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Nearly level to gently sloping; seasonal high water table.	Erodible; seasonal high water table.
Seasonal high water table; moderately slow permeability.	Slow rate of seepage.	Fair stability; slow permeability; good compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Nearly level to gently sloping; seasonal high water table.	Erodible; seasonal high water table.
Bedrock at depths of 1 to 1½ feet; clayey material.	Bedrock at depths of 1 to 1½ feet; some areas have high seepage rate.	Fair stability; slow permeability.	Well drained.....	Moderately slow permeability; medium to rapid runoff; low water-holding capacity.	Gently to strongly sloping; erodible; bedrock at depths of 1 to 1½ feet.	Erodible; bedrock at depths of 1 to 1½ feet.
Steepness.....	Excessive rate of seepage in substratum.	Permeable; good compaction.	Well drained.....	Rapid infiltration; low water-holding capacity.	Steepness; erodible.	Steepness; erodible.
Subject to flooding.	Subject to flooding; permeable substratum.	Fair stability; slow permeability; fair to good compaction.	Well drained.....	Moderate permeability; high water-holding capacity; subject to flooding.	Nearly level; subject to flooding.	Subject to flooding.
No limiting features.	Slow rate of seepage.	Fair stability; slow permeability; fair compaction.	Well drained.....	Moderately permeable to depth of 40 inches; high water-holding capacity.	Erodible on stronger slopes.	Erodible.
Seasonal high water table; subject to flooding; moderately slow permeability.	Subject to flooding; seasonal high water table; permeable layers in substratum.	Fair stability; slow permeability; good compaction.	Moderately slow permeability; seasonal high water table.	High water-holding capacity; seasonal high water table; subject to flooding.	Nearly level; subject to flooding.	Nearly level; subject to flooding.
Seasonal high water table; moderately slow permeability.	Excessive rate of seepage in substratum.	Good stability; slow permeability; good compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability; high water-holding capacity.	Nearly level; seasonal high water table.	Nearly level; seasonal high water table.
Seasonal high water table; subject to flooding; moderately slow permeability.	Subject to flooding; slow rate of seepage.	Fair stability; slow permeability; good compaction.	Seasonal high water table; moderately slow permeability; subject to flooding.	Seasonal high water table; moderately slow permeability.	No adverse features.	Subject to flooding.
No limiting features.	Excessive rate of seepage in substratum.	Good stability; slow permeability; good compaction.	Seasonal high water table in some places.	High water-holding capacity.	No adverse features.	Erodible.

TABLE 5.—*Interpretations of 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	Substratum
Tippecanoe (TpA, TpB)-----	Poor-----	Moderate to high.	Good-----	Good; well graded and stratified.	Fair-----	Good-----
Warsaw (WaA)-----	Fair; good below a depth of 35 inches.	Low-----	Good-----	Good; well graded and stratified.	Good-----	Good-----
Wea (WeA)-----	Fair; good below a depth of 50 inches.	Moderate-----	Good-----	Good for gravel, good for sand; well graded and stratified.	Fair-----	Good-----
Westland (Wn, Ws)-----	Poor-----	High-----	Good-----	Good; well graded and stratified.	Fair-----	Good-----
Wynn (WyB, WyB2, WyC2)-----	Poor-----	Moderate-----	Fair-----	Not suitable-----	Poor-----	Unsuitable; moderately deep to bedrock.
Xenia (XeA, XeB, XeB2)-----	Poor-----	High-----	Good-----	Not suitable-----	Fair-----	Fair-----

¹ Where these soils occur in the boulder belt, as shown on the general soil map, earthmoving and trenching may be hampered by the many boulders on the surface and throughout the soil profile.

Land Use Planning: Soils and Rural-Fringe Development³

The area that is now Preble County was once covered mainly by forests, most of which have been cleared for farming. At present, most of the land is used for crops. There are small acreages of pasture and some land remaining in forests.

Within the past 10 years, however, an increasing amount of land has been taken out of agriculture and used for residential, commercial, industrial, and recreational purposes.

Preble County is close to such expanding communities as Dayton, Ohio, and Richmond, Ind., and it lies between Columbus and Indianapolis. Railroads provide convenient points for shipping. Additional highways may be constructed as the population of the county increases.

³ Prepared by RALPH MEEKER, soil scientist (specialist), and RICHARD L. GOOGINS, assistant State soil scientist.

Increased competition for the use of land can be expected as more acreage is converted from agriculture to urban uses. Eaton, the largest urban area, is growing, as are smaller communities such as Gratis, West Alexandria, and Lewisburg. The townships in the eastern and southern part of the county are within commuting distance of Dayton, Middletown, and Hamilton. As a result, additional rural land may be developed for housing.

This section provides information on the properties of the soils and their effect on selected rural-fringe uses. This information can be useful as a guide for overall land-use planning.

Table 6 gives the estimated degree and the kinds of limitations of the soils for selected land uses. Individual and group planners can find additional information on the detailed soil map and in other parts of this survey. Through the use of this information, comparisons can be made among the soils in the county for a particular land use. Thus, the information can be used as a basis for long-range planning and zoning.

properties of the soils—Continued

Soil features affecting suitability for engineering practices for—						
Highway location	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir area	Embankment				
No limiting features.	Excessive rate of seepage in substratum.	Good stability; permeable; good compaction.	Seasonal high water table in some places.	High water-holding capacity.	No adverse features.	Erodible.
No limiting features.	Excessive rate of seepage in substratum.	Adequate strength and stability; permeable; fair to poor compaction.	Well drained.....	Medium water-holding capacity.	No adverse features.	No adverse features.
No limiting features.	Excessive rate of seepage in substratum.	Good stability; permeable; good compaction.	Well drained.....	High water-holding capacity.	No adverse features.	No adverse features.
Seasonal high water table; moderately slow permeability.	Excessive rate of seepage in substratum.	Stable; permeable; fair compaction.	Seasonal high water table; moderately slow permeability to a depth of about 30 inches.	Seasonal high water-holding capacity; moderately slow permeability.	Nearly level; seasonal high water table.	Seasonal high water table; nearly level.
Bedrock at depths of 1½ to 3 feet.	Bedrock at depths of 1½ to 3 feet.	Fair stability; moderately slow permeability; good compaction.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Gently sloping to sloping; erodible; bedrock at depths of 1½ to 3 feet.	Erodible; bedrock at depths of 1½ to 3 feet.
Moderately slow permeability.	Slow rate of seepage.	Fair stability; slow permeability; fair to good compaction.	Seasonal high water table; moderately slow permeability.	Moderately slow permeability.	Erodible.....	Erodible.

² Too variable to be rated.

Extensive manipulation of a soil will alter some of its natural properties. Therefore, in areas where there has been extensive cutting and filling of material, the ratings in table 6 no longer apply for some uses.

The ratings in table 6 represent the typical conditions for each kind of soil shown on the detailed soil map. The limitation at a particular site or on a particular lot may vary in degree and kind from that listed in table 6 because of the natural variation within any one soil area. Supplementary onsite investigations should be made before using the soils for the purposes listed in table 6, particularly where considerable cost is involved.

Any one particular soil property may impose a degree of limitation for a specified land use. This same soil property can also impose a limitation for another land use. Therefore, for comparison, the estimated degree of limitation for each soil and specified land use is given as *slight*, *moderate*, and *severe*. A rating of *slight* indicates that the soil presents no important limitation to the specified use. A rating of *moderate* shows that the soil presents some

limitations. Such limitations need to be recognized, but they can be overcome or corrected. A rating of *severe* indicates that the soil presents serious problems to the specific use. These problems are difficult to overcome, but a rating of *severe* does not mean that the soil cannot be used for the specific use.

Following is a discussion of the specific land uses for which the soils are rated.

Cultivated crops

Currently, most of the rural land in Preble County is used for agriculture. But most changes in land use are from agricultural to nonagricultural use. Such changes tend to be irreversible.

In table 6 the soils have been rated for the growing of cultivated crops. The degree of limitation is based on the land capability class to which a soil belongs. Hazards to crops, such as erosion, wetness, droughtiness, and stoniness, are considered in these ratings.

TABLE 6.—*Estimated degree and kind of limitation*
 [Properties of Gravel pits (Gp), Made land and Borrow

Soil series and map symbols	Cultivated crops	Sewage disposal		Lawns, landscaping, and golf fairways
		Septic tank filter fields	Sewage lagoons	
Birkbeck (BbA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Slight-----
Bonpas (Bn, Bo)-----	Slight-----	Severe: moderately slow permeability; ponding; seasonal high water table.	Slight-----	Severe: seasonal high water table.
Brookston (BrA, BsA)-----	Slight-----	Severe: moderately slow permeability; seasonal high water table.	Slight-----	Severe: seasonal high water table.
Casco (CaE2, CaF2, CaF3)----- (For Rodman and Fox parts, refer to the Rodman and Fox series.)	Severe: slope-----	Severe: slope-----	Severe: slope; rapid permeability.	Severe: slope; droughtiness.
Celina: (CbB)-----	Slight: boulders-----	Severe: moderately slow permeability; boulders.	Moderate: slope; boulders.	Slight-----
(CeA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Slight-----
(CeB, CeB2)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope-----	Slight-----
(CmC2)----- (For Miami part, refer to the Miami series.)	Moderate: slope; erosion-----	Severe: moderately slow permeability.	Severe: slope-----	Moderate: slope-----
Channahon (CnE2)----- (For Fairmount part, refer to the Fairmount series.)	Severe: slope; shallow to bedrock-----	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.
Corwin: (CoA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Slight-----
(CoB)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope-----	Slight-----
Crane (Cr)-----	Slight-----	Moderate: somewhat poorly drained.	Severe: permeable substratum.	Moderate: somewhat poorly drained.
Crosby: (CsA)-----	Slight: boulders-----	Severe: boulders; moderately slow permeability.	Moderate: boulders.	Moderate: somewhat poorly drained.
(CsB)-----	Slight: boulders-----	Severe: boulders; moderately slow permeability.	Moderate: boulders; slope.	Moderate: somewhat poorly drained.

See footnotes at end of table.

of the soils for selected rural-fringe uses

pits (Mb), and Quarries (Qu) were too variable to be estimated]

Subdivisions		Recreational facilities			Cemeteries and trench type sanitary land fill
Homesites ¹	Streets and parking lots	Athletic fields	Parks and play areas	Tent campsites ²	
Slight.....	Slight.....	Moderate: moderately slow permeability.	Slight.....	Slight.....	Moderate: moderately slow permeability.
Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: moderately slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table; ponding.	Severe: moderately slow permeability; seasonal high water table.
Severe: seasonal high water table.	Severe: seasonal high water table	Severe: moderately slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table; ponding.	Severe: seasonal high water table.
Severe: slope.....	Severe: slope.....	Severe: slope.....	Severe: slope.....	Severe: slope.....	Severe: slope.
Slight.....	Moderate: slope.....	Moderate: slope; moderately slow permeability.	Slight.....	Slight.....	Severe: boulders.
Slight.....	Slight.....	Moderate: moderately slow permeability.	Slight.....	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.
Slight.....	Moderate: slope.....	Moderate: slope; moderately slow permeability.	Slight.....	Slight.....	Moderate: moderately slow permeability.
Moderate: slope.....	Severe: slope.....	Severe: slope.....	Moderate: slope.....	Moderate: slope.....	Moderate: slope; moderately slow permeability.
Severe: slope; shallow to bed-rock.	Severe: slope; shallow to bed-rock.	Severe: slope.....	Severe: slope.....	Severe: slope.....	Severe: slope; shallow to bed-rock.
Slight.....	Slight.....	Moderate: moderately slow permeability.	Slight.....	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.
Slight.....	Moderate: slope.....	Moderate: moderately slow permeability; slope.	Slight.....	Slight.....	Moderate: moderately slow permeability.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Moderate: somewhat poorly drained; boulders.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; moderately slow permeability.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: boulders; moderately slow permeability.
Moderate: somewhat poorly drained; boulders.	Moderate: somewhat poorly drained; slope.	Moderate: somewhat poorly drained; moderately slow permeability; slope.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: boulders; moderately slow permeability.

TABLE 6.—*Estimated degree and kind of limitation*

Soil series and map symbols	Cultivated crops	Sewage disposal		Lawns, landscaping, and golf fairways
		Septic tank filter fields	Sewage lagoons	
Crosby—Continued (CtA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Moderate: somewhat poorly drained.
(CyB)----- (For Celina part, refer to the Celina series.)	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Moderate: somewhat poorly drained.
Dana: (DaA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Slight-----
(DaB)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Slight-----
Fairmount (FaF2)-----	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.	Severe: slope; shallow to bedrock.
Fincastle: (FcA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Moderate: somewhat poorly drained.
(FcB)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Moderate: somewhat poorly drained.
Fox: (FgA)-----	Slight-----	Slight ³ -----	Severe: ³ permeable material.	Slight: droughty.
(FgB, FgB2)-----	Slight-----	Slight ³ -----	Severe: ³ permeable material.	Slight: droughty.
(FgC2)-----	Moderate: slope and erosion.	Moderate: ³ slope-----	Severe: ³ permeable material; slope.	Moderate: slope--
(F1A, FmA)-----	Slight-----	Slight ³ -----	Severe: ³ permeable material.	Slight: droughty.
(F1B, F1B2, FmB, FmB2)-----	Slight-----	Slight ³ -----	Severe: permeable material.	Slight: droughty.
(F1C2, FmC2)-----	Moderate: slope; erosion.	Moderate ³ -----	Severe: permeable material; slope.	Moderate: slope--
(FsC3)-----	Severe: slope; erosion.	Moderate: ³ slope-----	Severe: ³ slope--	Severe: erosion--
(FmD2, FsD3)-----	Severe: slope; erosion.	Severe: ³ slope-----	Severe: ³ slope--	Severe: slope; erosion.

See footnotes at end of table.

TABLE 6.—*Estimated degree and kind of limitation*

Soil series and map symbols	Cultivated crops	Sewage disposal		Lawns, landscaping, and golf fairways
		Septic tank filter fields	Sewage lagoons	
Gullied land: (GuC)-----	Severe: severely eroded.	Severe: moderately slow permeability.	Severe: slope----	Severe: severely eroded.
(GuD, GuF)-----	Severe: severely eroded.	Severe: moderately slow permeability; slope.	Severe: slope----	Severe: severely eroded; slope.
Hennepin (Mapped only with Miami and Fox soils.)	Severe: slope; erosion.	Severe: slope-----	Severe: slope----	Severe: slope----
Kendallville: (Mapped only with Ockley soils.) (OkA)-----	Slight-----	Moderate: upper horizons moderately permeable.	Moderate: permeability.	Slight-----
(OkB, OkB2)-----	Slight-----	Moderate: upper horizons moderately permeable.	Moderate: slope--	Slight-----
(OkC2)-----	Moderate: slope.	Moderate: slope-----	Severe: slope----	Moderate: slope--
(OkD2, OIC3, OID3)-----	Severe: slope; erosion.	Severe: slope-----	Severe: slope----	Severe: slope----
Landes: (La, Ld)-----	Slight-----	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
(Lg)-----	Moderate: droughty.	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
Lewisburg: (LsB, LsB2)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Slight-----
(LtC3)-----	Severe: severely eroded.	Severe: moderately slow permeability.	Severe: slope----	Severe: low available moisture.
Medway (Md)-----	Slight-----	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
Miami (MeC2)-----	Moderate: boulders; slope; erosion.	Severe: boulders; moderately slow permeability.	Severe: slope----	Moderate: slope--
(MIC, MIC2)-----	Moderate: slope--	Severe: boulders; moderately slow permeability.	Severe: slope----	Moderate: slope--
(MID, MID2)-----	Severe: slope----	Severe: boulders; moderately slow permeability; slope.	Severe: slope----	Severe: slope----
(MnB, MnB2) (For Celina part of these units, refer to Celina series.)	Slight-----	Severe: boulders; moderately slow permeability.	Moderate: slope--	Slight-----
(MoB, MoB2) (For Celina part of these units, refer to the Celina series.)	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Slight-----
(MpB3) (For Celina part, refer to the Celina series.)	Moderate: erosion.	Severe: moderately slow permeability.	Moderate: slope--	Moderate: erosion.

See footnotes at end of table.

of the soils for selected rural-fringe uses—Continued

Subdivisions		Recreational facilities			Cemeteries and trench type sanitary land fill
Homesites ¹	Streets and parking lots	Athletic fields	Parks and play areas	Tent campsites ²	
Moderate: slope---	Moderate: Slope---	Severe: slope-----	Severe: slope; erosion.	Severe: slope; erosion.	Moderate: slope; erosion.
Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope; erosion.	Severe: slope; erosion.	Severe: slope.
Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope.
Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: permeability.
Slight-----	Moderate: slope---	Moderate: slope---	Slight-----	Slight-----	Moderate: permeability.
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope---	Moderate: slope---	Moderate: permeability.
Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope.
Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding
Severe: subject to flooding.	Severe: subject to flooding.	Moderate: gravelly surface layer subject to flooding.	Slight-----	Severe: subject to flooding.	Severe: subject to flooding.
Slight-----	Moderate: slope---	Moderate: slope; moderately slow permeability.	Slight-----	Slight-----	Moderate: moderately slow permeability.
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope---	Moderate: slope---	Moderate: moderately slow permeability.
Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope---	Moderate: slope---	Moderate: slope; moderately slow permeability.
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope---	Moderate: slope---	Moderate: slope; moderately slow permeability.
Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope.
Slight-----	Moderate: slope---	Moderate: slope---	Slight-----	Slight-----	Severe: boulders; moderately slow permeability.
Slight-----	Moderate: slope---	Moderate: slope---	Slight-----	Slight-----	Moderate: moderately slow permeability.
Slight-----	Moderate: slope---	Moderate: slope; surface layer texture.	Moderate: surface layer texture.	Moderate: surface layer texture.	Moderate: moderately slow permeability.

TABLE 6.—*Estimated degree and kind of limitation*

Soil series and map symbols	Cultivated crops	Sewage disposal		Lawns, landscaping, and golf fairways
		Septic tank filter fields	Sewage lagoons	
Miami—Continued (MmC3)-----	Severe: slope; erosion.	Severe: moderately slow permeability.	Severe: slope----	Severe: erosion----
(MmD3, MrE2, MrE3, MrF2, MrF3) (For properties of Fox and Hennepin soils in these units, refer to those series.)	Severe: slope; erosion.	Severe: moderately slow permeability; slope.	Severe: slope----	Severe: erosion; slope.
Millsdale (MsA, MtA)-----	Moderate: wetness.	Severe: moderately slow permeability.	Severe: less than 3 feet to bedrock.	Severe: very poorly drained.
Milton: (MuA)-----	Slight-----	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.
(MuB, MuB2)-----	Moderate: slope--	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.
(MuC2)-----	Severe: slope; erosion.	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.
(MvC3)-----	Severe: severely eroded.	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Severe: erosion.
Ockley: (OcA, OkA, OkB) (For Kendallville part of OkA and OkB, refer to the Kendallville series.)	Slight-----	Slight ³ -----	Severe ³ : permeability.	Slight-----
(OcB, OkB2) (For Kendallville part of OkB2, refer to the Kendallville series.)	Slight-----	Slight ³ -----	Severe ³ : permeability; slope.	Slight-----
(OkC2) (For Kendallville part, refer to the Kendallville series.)	Moderate: slope; erosion.	Moderate ³ : slope-----	Severe ³ : slope----	Moderate: slope.
(OIC3) (For Kendallville part, refer to the Kendallville series.)	Severe: erosion----	Moderate ³ : slope-----	Severe ³ : slope----	Severe: erosion.
(OkD2, OID3) (For Kendallville part, refer to the Kendallville series.)	Severe: slope; erosion.	Severe: slope-----	Severe: slope----	Severe: slope; erosion.
Odell (OsB)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Moderate: somewhat poorly drained.
Plattville (PIB)-----	Slight-----	Severe: moderately slow permeability; limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.
Pyrmont: (PyA)-----	Moderate: wetness.	Severe: moderately slow permeability.	Slight-----	Moderate: somewhat poorly drained.
(PyB)-----	Moderate: wetness.	Severe: moderately slow permeability.	Moderate: slope--	Moderate: somewhat poorly drained.

See footnotes at end of table.

of the soils for selected rural-fringe uses—Continued

Subdivisions		Recreational facilities			Cemeteries and trench type sanitary land fill
Homesites ¹	Streets and parking lots	Athletic fields	Parks and play areas	Tent campsites ²	
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope; surface layer texture.	Moderate: slope; surface layer texture.	Moderate: moderately slow permeability; slope.
Severe: slope---	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope.
Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Moderate: limited depth to bedrock.	Severe: very poorly drained.	Severe: very poorly drained.
Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.	Moderate: limited depth to bedrock.	Moderate: limited depth to bedrock.	Severe: limited depth to bedrock.
Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock; slope.	Moderate: limited depth to bedrock.	Moderate: limited depth to bedrock.	Severe: limited depth to bedrock.
Severe: limited depth to bedrock.	Severe: limited depth to bedrock; slope.	Severe: slope-----	Moderate: slope---	Moderate: limited depth to bedrock; slope.	Severe: limited depth to bedrock.
Severe: limited depth to bedrock.	Severe: limited depth to bedrock; slope.	Severe: slope-----	Moderate: slope---	Moderate: limited depth to bedrock; slope.	Severe: limited depth to bedrock.
Slight-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight: (sanitary land fill. ³)
Slight-----	Moderate: slope---	Moderate: slope---	Slight-----	Slight-----	Slight: (sanitary land fill. ³)
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope---	Moderate: slope---	Moderate: slope; (sanitary land fill. ³)
Moderate: slope---	Severe: slope-----	Severe: slope-----	Moderate: slope---	Moderate: slope---	Moderate: slope; (sanitary land fill. ³)
Severe: slope---	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope-----	Severe: slope.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: moderate slow permeability.
Severe: limited depth to bedrock.	Moderate: slope---	Moderate: slope; moderately slow permeability; limited depth to bedrock.	Moderate: limited depth to bedrock.	Moderate: limited depth to bedrock.	Severe: limited depth to bedrock.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slope.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained.

Table 6.—*Estimated degree and kind of limitation*

Soil series and map symbols	Cultivated crops	Sewage disposal		Lawns, landscaping, and golf fairways
		Septic tank filter fields	Sewage lagoons	
Ragsdale (Ra)-----	Slight-----	Severe: very poorly drained--	Slight-----	Severe: very poorly drained.
Randolph: (RcA)-----	Moderate: wet- ness.	Severe: moderately slow permeability; limited depth to bedrock.	Severe: limited depth to bed- rock.	Moderate: limited depth to bed- rock.
(RcB)-----	Moderate: wet- ness.	Severe: moderately slow permeability; limited depth to bedrock.	Severe: limited depth to bed- rock.	Moderate: limited depth to bed- rock.
Raub (RdA) (For Dana part, refer to the Dana series.)	Slight-----	Severe: moderately slow permeability.	Slight-----	Moderate: some- what poorly drained.
Reesville (ReA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Moderate: some- what poorly drained.
Rithey and Channalon (RhB2, RhC2, RhD2, RnC3, RnD3; ratings are the same for both soil series.)	Severe: shallow to bedrock.	Severe: shallow to bedrock--	Severe: shallow to bedrock.	Severe: shallow to bedrock.
Riverwash (Ro)-----	Severe: subject to flooding.	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
Rodman (Mapped only with Caseo and Fox soils).	Severe: slope; erosion.	Severe: steep slopes-----	Severe: steep slopes.	Severe: steep slopes.
Ross (Rs)-----	Slight: subject to flooding.	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
Russell: (RuA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Slight-----
(RuB, RuB2)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope--	Slight-----
(RuC2)-----	Moderate: slope; erosion.	Severe: moderately slow permeability.	Severe: slope--	Moderate: slope--
(RuD2, RvD3)-----	Severe: slope; erosion.	Severe: moderately slow permeability; slope.	Severe: slope--	Severe: slope--
(RvC3)-----	Severe: slope; erosion.	Severe: moderately slow permeability.	Severe: slope--	Severe: erosion--
Shoals (Sh)-----	Slight: subject to flooding.	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
Sleeth (SIA)-----	Slight-----	Severe: moderately slow permeability.	Severe: ³ perme- able substratum.	Moderate: some- what poorly drained.
Sloan (So)-----	Moderate: sub- ject to flooding.	Severe: subject to flooding--	Severe: subject to flooding.	Severe: subject to flooding.
Thackery: (ThA)-----	Slight-----	Slight ³ -----	Severe: ³ perme- able substratum.	Slight-----
(ThB)-----	Slight-----	Slight ³ -----	Severe: ³ perme- able substratum.	Slight-----

See footnotes at end of table.

of the soils for selected rural-fringe uses—Continued

Subdivisions		Recreational facilities			Cemeteries and trench type sanitary land fill
Homesites ¹	Streets and parking lots	Athletic fields	Parks and play areas	Tent campsites 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: limited depth to bedrock.	Moderate: somewhat poorly drained.	Moderate: moderately slow permeability; limited depth to bedrock.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: limited depth to bedrock.
Severe: limited depth to bedrock.	Moderate: slope; somewhat poorly drained.	Moderate: moderately slow permeability; limited depth to bedrock.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: limited depth to bedrock.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained.
Severe: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.	Severe: steep slopes.
Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Slight.....	Slight.....	Slight.....	Slight.....	Slight.....	Slight.
Slight.....	Moderate: slope....	Moderate: slope....	Slight.....	Slight.....	Slight.
Moderate: slope..	Severe: slope....	Severe: slope....	Moderate: slope....	Moderate: slope....	Moderate: slope.
Severe: slope....	Severe: slope....	Severe: slope....	Severe: slope....	Severe: slope....	Severe: slope.
Moderate: slope..	Severe: slope....	Severe: slope....	Moderate: slope....	Moderate: slope....	Moderate: slope.
Severe: subject to flooding.	Severe: subject to flooding.	Moderate: somewhat poorly drained; subject to flooding.	Moderate: somewhat poorly drained; subject to flooding.	Moderate: somewhat poorly drained; subject to flooding.	Severe: subject to flooding.
Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: moderately slow permeability.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: somewhat poorly drained.
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: ³ (sanitary land fill.)
Slight.....	Moderate: slope....	Moderate: slope....	Slight.....	Slight.....	Slight: ³ (sanitary land fill.)

Table 6.—Estimated degree and kind of limitation

Soil series and map symbols	Cultivated crops	Sewage disposal		Lawns, landscaping, and golf fairways
		Septic tank filter fields	Sewage lagoons	
Tippecanoe (TpA, TpB)-----	Slight-----	Slight ³ -----	Severe: ³ permeable substratum	Slight-----
Warsaw (WaA)-----	Slight-----	Slight ³ -----	Severe: ³ permeable substratum	Slight-----
Wea (WeA)-----	Slight-----	Slight ³ -----	Severe: ³ permeable substratum	Slight-----
Westland (Wn, Ws)-----	Slight-----	Severe: very poorly drained	Severe: ³ permeable substratum	Severe: very poorly drained.
Wynn: (WyB, WyB2)-----	Slight-----	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.
(WyC2)-----	Moderate: slope; erosion.	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: slope
Xenia: (XeA)-----	Slight-----	Severe: moderately slow permeability.	Slight-----	Slight-----
(XeB, XeB2)-----	Slight-----	Severe: moderately slow permeability.	Moderate: slope	Slight-----

¹ Rated for homes of three stories or less.

² Trailer campsites rate the same except for slopes: 0 to 2 percent slopes rate *slight*, 2 to 6 percent rate *moderate*, 6 percent or more rate *severe*.

Ratings for cultivated crops are given in this table to aid land use planners when considering agriculture as a sound land use.

Homesites

These locations are for homes that are three stories or less and have a basement, but the ratings also apply to sites for small industrial, commercial, and institutional buildings.

Most of the acreage taken from agriculture is being converted to new residential developments. These developments generally surround present urban areas. In addition, individual houses and small groups of houses are being built throughout the county.

Soil properties and some related site characteristics that were used in rating homesite locations included depth to bedrock, slope, natural drainage, flood hazard, and surface stoniness or rockiness. The method of sewage disposal was not considered in these ratings.

Soils subject to flooding have *severe* limitations for homesites. While flooding is infrequent, it is costly and damaging when it does occur. Homes on naturally wet soils, such as the Brookston, Crosby, Fincastle, and Ragsdale, have the hazard of wet basements if adequate drainage is not provided. In many areas of the county, well-developed systems of tile and open ditch drains have been installed for agricultural uses. Excavations in these areas

for buildings can disrupt the established drainage system, and the soils then revert to their natural condition of wetness.

Some soils, such as Ragsdale and Birkbeck, have a high silt content. These soils are not so favorable for supporting structural foundations as coarser textured soils. Soils that have high shrink-swell properties are likely to heave and crack foundations unless special precautions are taken. Also, high shrink-swell properties affect the alignment of sidewalks, patios, floors, and rock walls. To minimize this effect, use a subgrade or layers of sandy or gravelly material below the structure.

Excavating basements and installation of underground utility lines are difficult and expensive in soils that have limited depth to bedrock. Soils having slopes greater than 12 percent have an erosion hazard and are difficult to excavate and level.

Septic tank filter fields

Soil properties important to the installation and operation of septic tank filter (disposal) fields include permeability, depth to bedrock, slope, natural drainage, level of the water table, and hazard of flooding. Use of a soil for the disposal of effluent is severely limited by flooding, by very poor natural drainage, and by moderately slow, slow, or very slow permeability. (Permeability of each soil in the county has been estimated and is shown in table 4.)

of the soils for selected rural-fringe uses—Continued

Subdivisions		Recreational facilities			Cemeteries and trench type sanitary land fill
Homesites ¹	Streets and parking lots	Athletic fields	Parks and play areas	Tent campsites ²	
Slight.....	Slight: (moderate on B slope.)	Slight: (moderate on B slope.)	Slight.....	Slight.....	Slight: (sanitary land fill. ³)
Slight.....	Slight.....	Slight.....	Slight.....	Slight.....	Slight: (sanitary land fill. ³)
Slight.....	Slight.....	Slight.....	Slight.....	Slight.....	Slight: (sanitary land fill. ³)
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: limited depth to bedrock.	Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Moderate: limited depth to bedrock.	Moderate: limited depth to bedrock.	Severe: limited depth to bedrock.
Severe: limited depth to bedrock.	Severe: limited depth to bedrock.	Severe: limited depth to bedrock; slope.	Moderate: limited depth to bedrock.	Moderate: limited depth to bedrock.	Severe: limited depth to bedrock.
Slight.....	Slight.....	Slight.....	Slight.....	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.
Slight.....	Moderate: slope....	Moderate: slope....	Slight.....	Slight.....	Moderate: moderately slow permeability.

³ Pollution hazard to nearby streams, lakes, springs, or undergrown water supply because of inadequate filtration.

If filter fields for septic tanks are located on slopes of more than 12 percent, erosion and seepage down slope can be a problem; also, the soil might become unstable when saturated. A *severe* limitation is imposed by a restrictive layer, such as solid bedrock, a dense, compact layer, or a layer of clay that restricts filtration and the movement of the effluent from the soil.

Some soils in the county have a gravelly and sandy substratum or are underlain by creviced bedrock through which effluent that is inadequately filtered can contaminate ground water or nearby springs, lakes, or streams. Before a septic tank system is installed on a particular site an on-site investigation should be made at the proposed site to determine the limitations of the soil and possible included soils.

Sewage lagoons

Sewage lagoons are shallow ponds built to dispose of sewage through oxidation. They may be needed if septic tanks or a central sewage system is not practical. Among the features that control the degree of limitation of a soil for sewage lagoons are the hazard of flooding, degree of slope, depth to bedrock, and rate of permeability.

Lawns, landscaping, and golf fairways

Most soils in the county are suitable sources of topsoil, as indicated in table 5 of the section "Engineering Uses of

the Soils." During construction the upper foot of natural surface soil can be scalped and pushed aside into a stockpile. After grading has been completed it can be distributed over the area. Thus, the soil will have a good root zone for lawns, flowers, shrubs, and trees. In areas being developed for streets, the surface soil can be scalped in a like manner and used to improve adjacent areas where needed most.

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

This column rates the suitability of the soils for streets and parking lots in subdivisions. The ratings apply to streets and parking lots not subject to continual heavy traffic. Soil characteristics that affect this use include drainage, slope, depth to bedrock, hazard of flooding, and stoniness or rockiness. In subdivisions, soils having slopes of more than 6 percent are rated *severe* for this use. Tables 4 and 5 in the section "Engineering Uses of the Soils" give additional information about the soils that is important for streets and parking lots. The degree of slope that should be designed for the side of cuts and fills depends on the

erodibility of the soil and its capacity to support close-growing vegetation.

Recreational facilities

Recreation is becoming increasingly important in Preble County. All the soils in the county are suitable for one or more kinds of recreational development. Soils on flood plains are suited to extensive play areas because they generally occur in long, winding areas along streams and adjacent scenic hills. They are also suitable for intensive play areas, such as baseball diamonds, picnic areas and tennis courts, that are not used during normal periods of flooding and are not subject to costly damage by floodwater. Use of soils on flood plains for homes, highways, and most other nonfarm uses is severely limited by flooding. In addition, construction in these areas might hold back the natural flow of floodwater.

Tent campsites.—These should be located in areas where the landscape is attractive, the trafficability is good, and the productivity of grasses and trees is medium or high. Soils in which natural drainage is good or moderately good have less serious limitations than wetter soils. Limitations are *moderate* on somewhat poorly drained soils and *severe* on poorly drained and very poorly drained 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, soils that have slopes of more than 12 percent have *severe* limitations. Soils that are firm when moist and nonsticky when wet are desirable for campsites. 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* on soils that have a surface layer of clay loam, sandy clay loam, silty clay loam, or loamy sand. They are *moderate* or *severe* on gravelly, stony, or rocky soils and *severe* on loose sandy soils and on very gravelly or very channery soils.

Athletic fields and other intensive play areas.—These fairly small tracts are used for baseball, football, tennis, volleyball, badminton, and other sports. Because the areas must be nearly level, considerable shaping may be needed. Consequently, the limitation is *moderate* or *severe* for soils that have slopes of more than 2 percent. The texture of the surface layer is important. Soils having a surface layer of silt loam, fine sandy loam, very fine sandy loam, loam, or sandy loam have only a *slight* limitation for intensive play areas. Soils having a surface layer of clay loam, sandy clay loam, silty clay loam, or loamy sand have a *moderate* limitation. Loose sandy soils, gravelly soils, and very stony, flaggy, and rocky soils have a *severe* limitation.

Parks and play areas.—These areas can be located on many kinds of soils. Areas consisting of several different soils provide a variety of wildlife and natural vegetation. 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 so as to control gullyng.

Cemeteries and sanitary land fills

Soils that are deep, are well drained or moderately well drained, and have slopes of less than 12 percent have *slight* or *moderate* limitation for use as cemeteries. 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 that is near the surface, but it is only slightly or moderately limited if the underlying material is soft or rippable. Throughout the year, excavation is easier in the sandier soils. If caving is a problem, shoring the sides of excavations is necessary. Preserving the original surface soil is important, and liming and fertilizing are needed for maintaining sod.

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

Utility lines

The installation and maintenance of utility lines are affected by soil properties; however, the soils are not rated for this use in table 6. Depth to bedrock, natural drainage, level of the water table, and corrosion potential are among the main properties affecting utility lines. (Corrosion potential of all the soils in the county is shown in table 4.) The establishment, control, and maintenance of vegetation on utility rights-of-way are related to soil properties. The soil descriptions (see section "Descriptions of the Soils") point out other properties important to installation and maintenance of utility lines. During the planning of utility lines, their routing can be facilitated by the use of the soil survey.

Descriptions of the Soils

This section describes the soil series and mapping units of Preble County. The acreage and proportionate extent of each mapping unit are given in table 7.

First the soil series is described, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that 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 members of a soil series. Gravel pits, for example, is a miscellaneous land type that does not belong to a soil series. It is listed, nevertheless, in alphabetic order along with the soil series.

In comparing a mapping unit with a soil series, many readers will prefer to read the short description in paragraph form, rather than the technical description that identifies the A, B, and C horizons and depth ranges. The technical profile descriptions are mainly for soil scientists and others who want detailed information about soils.

Colors described are for a moist soil unless otherwise indicated. References to light-colored or dark-colored soils are to the color of the surface layer. A surface layer in which the color value is 4 or more (Munsell notation) is considered light colored. A color value of less than 4 (Munsell notation) denotes a dark-colored soil. This difference in color is easily observed in the field, and the terms "light-colored" or "dark-colored" soils are commonly used in Ohio. Terms used in the technical profile descriptions are

TABLE 7.—Acreage and proportionate extent of the soils

Soil	Area		Soil	Area	
	Acres	Percent		Acres	Percent
Birkbeck silt loam, 0 to 2 percent slopes	1, 527	0. 6	Miami silt loam, 6 to 12 percent slopes	715	0. 3
Bonpas silt loam	136	(¹)	Miami silt loam, 6 to 12 percent slopes, moderately eroded	13, 482	4. 9
Bonpas silty clay loam	125	(¹)	Miami silt loam, 12 to 18 percent slopes	236	. 1
Brookston silt loam, 0 to 2 percent slopes	22, 020	8. 0	Miami silt loam, 12 to 18 percent slopes, moderately eroded	2, 569	. 9
Brookston silty clay loam, 0 to 2 percent slopes	17, 836	6. 5	Miami soils, 6 to 12 percent slopes, severely eroded	10, 315	3. 8
Casco, Rodman, and Fox soils, 18 to 25 percent slopes, moderately eroded	270	. 1	Miami soils, 12 to 18 percent slopes, severely eroded	4, 893	1. 8
Casco, Rodman, and Fox soils, 25 to 50 percent slopes, moderately eroded	191	. 1	Miami-Celina bouldery silt loams, 2 to 6 percent slopes	312	. 1
Casco, Rodman, and Fox soils, 25 to 50 percent slopes, severely eroded	150	. 1	Miami-Celina bouldery silt loams, 2 to 6 percent slopes, moderately eroded	260	. 1
Celina bouldery silt loam, 2 to 6 percent slopes	520	. 2	Miami-Celina silt loams, 2 to 6 percent slopes	8, 580	3. 1
Celina silt loam, 0 to 2 percent slopes	4, 968	1. 8	Miami-Celina silt loams, 2 to 6 percent slopes, moderately eroded	18, 206	6. 6
Celina silt loam, 2 to 6 percent slopes	30, 596	11. 2	Miami-Celina soils, 2 to 6 percent slopes, severely eroded	153	. 1
Celina silt loam, 2 to 6 percent slopes, moderately eroded	12, 890	4. 7	Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, moderately eroded	2, 886	1. 1
Celina-Miami silt loams, 6 to 12 percent slopes, moderately eroded	147	. 1	Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, severely eroded	1, 571	. 6
Channahon and Fairmount soils, 18 to 25 percent slopes, moderately eroded	333	. 1	Miami, Fox, and Hennepin soils, 25 to 50 percent slopes, moderately eroded	4, 055	1. 5
Corwin silt loam, 0 to 2 percent slopes	338	. 1	Miami, Fox, and Hennepin soils, 25 to 50 percent slopes, severely eroded	481	. 2
Corwin silt loam, 2 to 6 percent slopes	531	. 2	Millsdale silt loam, 0 to 3 percent slopes	159	. 1
Crane silt loam	110	(¹)	Millsdale silty clay loam, 0 to 3 percent slopes	202	. 1
Crosby bouldery silt loam, 0 to 2 percent slopes	229	. 1	Milton silt loam, 0 to 2 percent slopes	214	. 1
Crosby bouldery silt loam, 2 to 6 percent slopes	150	. 1	Milton silt loam, 2 to 6 percent slopes	452	. 2
Crosby silt loam, 0 to 2 percent slopes	22, 397	8. 2	Milton silt loam, 2 to 6 percent slopes, moderately eroded	590	. 2
Crosby-Celina silt loams, 2 to 6 percent slopes	14, 198	5. 2	Milton silt loam, 6 to 12 percent slopes, moderately eroded	343	. 1
Dana silt loam, 0 to 2 percent slopes	123	(¹)	Milton soils, 6 to 12 percent slopes, severely eroded	84	(¹)
Dana silt loam, 2 to 6 percent slopes	344	. 1	Oekley silt loam, 0 to 2 percent slopes	855	. 3
Fairmount soils, 25 to 50 percent slopes, moderately eroded	939	. 3	Oekley silt loam, 2 to 6 percent slopes	718	. 3
Fincastle silt loam, 0 to 2 percent slopes	3, 446	1. 3	Oekley and Kendallville silt loams, 0 to 2 percent slopes	739	. 3
Fincastle silt loam, 2 to 6 percent slopes	570	. 2	Oekley and Kendallville silt loams, 2 to 6 percent slopes	1, 207	. 4
Fox gravelly loam, 0 to 2 percent slopes	97	(¹)	Oekley and Kendallville silt loams, 2 to 6 percent slopes, moderately eroded	1, 562	. 6
Fox gravelly loam, 2 to 6 percent slopes	94	(¹)	Oekley and Kendallville silt loams, 6 to 12 percent slopes, moderately eroded	1, 394	. 5
Fox gravelly loam, 2 to 6 percent slopes, moderately eroded	110	(¹)	Oekley and Kendallville silt loams, 12 to 18 percent slopes, moderately eroded	286	. 1
Fox gravelly loam, 6 to 12 percent slopes, moderately eroded	176	. 1	Oekley and Kendallville soils, 6 to 12 percent slopes, severely eroded	797	. 3
Fox loam, 0 to 2 percent slopes	199	. 1	Oekley and Kendallville soils, 12 to 18 percent slopes, severely eroded	578	. 2
Fox loam, 2 to 6 percent slopes	125	(¹)	Odell silt loam, 2 to 6 percent slopes	175	. 1
Fox loam, 2 to 6 percent slopes, moderately eroded	118	(¹)	Plattville silt loam, 2 to 6 percent slopes	251	. 1
Fox loam, 6 to 12 percent slopes, moderately eroded	94	(¹)	Pyrmont silt loam, 0 to 2 percent slopes	967	. 4
Fox silt loam, 0 to 2 percent slopes	1, 700	. 6	Pyrmont silt loam, 2 to 6 percent slopes	453	. 2
Fox silt loam, 2 to 6 percent slopes	1, 737	. 6	Quarries	74	(¹)
Fox silt loam, 2 to 6 percent slopes, moderately eroded	861	. 3	Ragsdale silt loam	3, 399	1. 2
Fox silt loam, 6 to 12 percent slopes, moderately eroded	545	. 2	Randolph silt loam, 0 to 2 percent slopes	194	. 1
Fox silt loam, 12 to 18 percent slopes, moderately eroded	121	(¹)	Randolph silt loam, 2 to 6 percent slopes	169	. 1
Fox soils, 6 to 12 percent slopes, severely eroded	363	. 1	Raub and Dana silt loams, 0 to 2 percent slopes	453	. 2
Fox soils, 12 to 18 percent slopes, severely eroded	110	(¹)	Reesville silt loam, 0 to 2 percent slopes	1, 745	. 6
Gravel pits	177	. 1	Ritchey and Channahon silt loams, 2 to 6 percent slopes, moderately eroded	207	. 1
Gullied land, rolling	114	(¹)	Ritchey and Channahon silt loams, 6 to 12 percent slopes, moderately eroded	410	. 1
Gullied land, hilly	351	. 1	Ritchey and Channahon silt loams, 12 to 18 percent slopes, moderately eroded	511	. 2
Gullied land, steep	124	(¹)	Ritchey and Channahon soils, 6 to 12 percent slopes, severely eroded	169	. 1
Landes gravelly sandy loam	122	(¹)			
Landes sandy loam	727	. 3			
Landes sandy loam, gravelly subsoil variant	1, 700	. 6			
Lewisburg silt loam, 2 to 6 percent slopes	1, 154	. 4			
Lewisburg silt loam, 2 to 6 percent slopes, moderately eroded	779	. 3			
Lewisburg soils, 6 to 12 percent slopes, severely eroded	196	. 1			
Made land and Borrow pits	52	(¹)			
Medway silt loam	2, 835	1. 0			
Miami bouldery silt loam, 6 to 12 percent slopes, moderately eroded	289	. 1			

TABLE 7.—*Acreage and proportionate extent of the soils—Continued*

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Ritchey and Channahon soils, 12 to 18 percent slopes, severely eroded	175	0.1	Thackery silt loam, 2 to 6 percent slopes	283	0.1
Riverwash	264	.1	Tippecanoe silt loam, 0 to 2 percent slopes	577	.2
Ross loam	9,000	3.3	Tippecanoe silt loam, 2 to 6 percent slopes	124	(¹)
Russell silt loam, 0 to 2 percent slopes	118	(¹)	Warsaw silt loam, 0 to 2 percent slopes	536	.2
Russell silt loam, 2 to 6 percent slopes	2,857	1.0	Wea silt loam, 0 to 2 percent slopes	336	.1
Russell silt loam, 2 to 6 percent slopes, moderately eroded	2,139	.8	Westland silt loam	3,469	1.3
Russell silt loam, 6 to 12 percent slopes, moderately eroded	1,478	.5	Westland silty clay loam	1,266	.5
Russell silt loam, 12 to 18 percent slopes, moderately eroded	586	.2	Wynn silt loam, 2 to 6 percent slopes	282	.1
Russell soils, 6 to 12 percent slopes, severely eroded	561	.2	Wynn silt loam, 2 to 6 percent slopes, moderately eroded	324	.1
Russell soils, 12 to 18 percent slopes, severely eroded	321	.1	Wynn silt loam, 6 to 12 percent slopes, moderately eroded	333	.1
Shoals silt loam	278	.1	Xenia silt loam, 0 to 2 percent slopes	3,549	1.3
Sleeth silt loam, 0 to 2 percent slopes	556	.2	Xenia silt loam, 2 to 6 percent slopes	1,904	.7
Sloan silt loam	2,253	.8	Xenia silt loam, 2 to 6 percent slopes, moderately eroded	272	.1
Thackery silt loam, 0 to 2 percent slopes	757	.3	Total land area	273,280	98.8
			Water	640	.2
			Total	273,920	100.0

¹ Less than 0.05 percent.

defined in the "Soil Survey Manual" (15). Many of the terms are defined in the Glossary at the back of this survey. The characterization numbers shown for some of the profiles refer to data in the section "Laboratory Data."

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil 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. After the series descriptions and descriptions of individual mapping units have been read, details about use and management of the soils can be learned from the section on management, which includes subsections on management for tilled crops, wildlife, woodland, engineering, and rural-fringe development.

Birkbeck Series

The Birkbeck series consists of deep, moderately well drained, nearly level to gently sloping soils that have formed in 36 to 60 inches of silty windblown material. The substratum is calcareous loam till of the Wisconsin age. These soils are in an area, known locally as the Boston Plains, west of the Camden moraine in west-central Preble County.

A typical Birkbeck soil that is cultivated has a plow layer of dark grayish-brown silt loam about 8 inches thick. The texture is silt loam to a depth of about 11 inches. Below this depth and down to about 46 inches, the subsoil is silty clay loam that is dark brown in the upper part and yellowish brown in the lower part. Plant roots penetrate to a depth of about 46 inches without much difficulty. Between depths of 46 and 53 inches, there is silt loam that is massive in place. Below 53 inches, there are many feet of loamy glacial till. The till is generally firm, and it restricts movement of water and growth of roots.

The Birkbeck soils have high available moisture capacity, low to medium organic-matter content, and moderate permeability. They are mostly slightly acid to neutral in reaction.

The Birkbeck soils are easy to cultivate and are cropped intensively. Crops respond well to fertilizer.

Technical description of a profile of Birkbeck silt loam, 0 to 2 percent slopes, in a cultivated field in Jackson Township, sec. 31, T. 8 N., R. 1 E.:

- Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; fine to medium granular structure; friable when moist, nonsticky and nonplastic when wet; roots abundant; slightly acid; lower boundary abrupt and smooth.
- A2—8 to 11 inches, dark-brown (10YR 4/3) silt loam; some indications of weak, thick, platy structure, but soil breaks to medium to coarse granular; friable when moist, nonsticky and nonplastic when wet; roots abundant; slightly acid; lower boundary abrupt and smooth.
- B1—11 to 15 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium, subangular blocky structure; firm when moist, slightly sticky when wet; roots abundant; medium acid; lower boundary diffuse.
- B21t—15 to 19 inches, dark-brown (10YR 4/3) silty clay loam; moderate, medium to coarse, subangular blocky structure; firm when moist, slightly sticky when wet; roots abundant; slightly acid; lower boundary diffuse.
- B22t—19 to 24 inches, yellowish-brown (10YR 5/4) silt loam; dark yellowish-brown (10YR 4/4) ped coatings; moderate, medium to coarse, subangular blocky structure; firm when moist, slightly sticky when wet; roots abundant; slightly acid; lower boundary diffuse.
- B23t—24 to 33 inches, yellowish-brown (10YR 5/6) silty clay loam; yellowish-brown (10YR 5/4) ped coatings; moderate to strong coarse, subangular blocky structure; firm when moist, slightly sticky when wet; roots abundant; neutral; lower boundary clear and wavy.
- B3—33 to 46 inches, yellowish-brown (10YR 5/6) silty clay loam; few, fine, faint, grayish-brown (10YR 5/2) mottles that occur as streaks; massive in place; very friable when moist, nonsticky when wet; roots common; neutral; lower boundary diffuse.
- C1—46 to 53 inches, yellowish-brown (10YR 5/6) silt loam; massive in place; very friable when moist, nonsticky when wet; some roots; neutral; lower boundary clear.

IIC2—53 to 59 inches, strong-brown (7.5YR 5/6), calcareous till of silt loam texture; massive in place; friable when moist; some roots; lower boundary gradual.

IIC3—59 to 73 inches, yellowish-brown (10YR 5/4), calcareous till of loam texture; massive in place; friable when moist; few roots.

The silty (loess) capping over the till is generally about 48 inches thick, but the range is from 36 to 60 inches. The depth to mottling ranges from 15 to about 35 inches. Minimum pH values occur in the upper part of the B horizon, and the reaction ranges from neutral to calcareous in the lower part of the loess layer.

The Birkbeck soils are commonly adjacent to the Xenia, Fincastle, Reesville, and Ragsdale soils. They have formed in thicker deposits of silty material than the Xenia and Fincastle soils; they are better drained than the Fincastle, Reesville, and Ragsdale soils.

Birkbeck silt loam, 0 to 2 percent slopes (BbA).—This soil occurs on slightly higher areas than the adjacent Reesville and Ragsdale soils. Included with it are some small areas of the somewhat poorly drained Reesville soils and the Xenia and Fincastle soils. In some places slopes are greater than 2 percent, and here erosion is a hazard. In most places, however, the erosion hazard is slight. (Capability unit I-1)

Bonpas Series

The Bonpas soils are dark colored and very poorly drained and have formed in water-laid silty and clayey materials. They are nearly level or in depressions and occur in large areas southwest of West Elkton and northwest of New Paris.

The surface layer is very dark brown silty clay loam. The subsoil is a heavy silty clay loam characterized by gray colors and some yellowish-brown mottles. The substratum consists of calcareous silty and clayey layers.

These soils have a high organic-matter content and moderately slow permeability. Surface runoff is slow to ponded. If these soils are drained, the root zone for such crops as corn and alfalfa is deep and available moisture capacity is high.

Most of the acreage of the Bonpas soils is farmed. These soils are suited to the general crops common to the area. Crops respond well to fertilizer.

Technical description of a profile of Bonpas silty clay loam in a previously cultivated field in Somers Township, sec. 36, T. 6 N., R. 2 E.:

Ap—0 to 8 inches, very dark brown (10YR 2/2) silty clay loam; moderate, medium, granular and subangular blocky structure; friable; slightly acid; lower boundary clear and smooth.

A1—8 to 10 inches, very dark brown (10YR 2/2) silty clay loam; strong, medium, angular blocky structure; firm; neutral; lower boundary abrupt and smooth.

B1g—10 to 16 inches, gray (10YR 5/1) heavy silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles and a few tongues of very dark brown (10YR 2/2); strong, medium, angular blocky structure; firm; neutral; lower boundary clear and smooth.

B21g—16 to 25 inches, gray (10YR 5/1) heavy silty clay loam; common, fine and medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; strong, medium, angular blocky structure; firm; neutral; lower boundary diffuse.

B22g—25 to 35 inches, gray (10YR 5/1) heavy silty clay loam; many, medium, prominent, yellowish-brown (10YR 5/4 and 5/6) mottles; strong, medium, angular and subangular blocky structure; firm; neutral; lower boundary diffuse.

B23g—35 to 45 inches, gray (10YR 5/1) heavy silty clay loam; many, medium, prominent, yellowish-brown (10YR 5/6 and 5/8) mottles; noticeable black (10YR 2/1) organic stains; moderate, medium, angular and subangular blocky structure; firm; neutral; lower boundary clear and smooth.

B3g—45 to 54 inches, yellowish-brown (10YR 5/6 and 5/8) silty clay loam; many, medium, prominent, gray (10YR 5/1) mottles; noticeable black (10YR 2/1) organic stains; moderate, medium, angular blocky structure; firm; mildly alkaline; lower boundary clear and smooth.

C—54 to 98 inches +, gray (10YR 5/1) laminated layers of silt loam and silty clay loam; massive; firm; calcareous.

The Ap horizon ranges from very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2). The total thickness of the A horizons ranges from 8 to 12 inches.

The B horizon ranges from about 36 to 46 inches in thickness and is light silty clay or silty clay loam.

The underlying laminated silt loam and silty clay loam have a few interspersed layers of loamy material.

Most areas of the Bonpas soils are near the better drained Wea and Ockley soils. They have less sand and more silt and clay below the surface layer than the adjacent Westland soils.

Bonpas silt loam (Bn).—The silt loam surface layer of this nearly level soil has formed in silty material washed in from higher surrounding soils. Otherwise, the profile of this soil is similar to that described for the series. Moderately slow permeability and seasonal wetness are the major limitations to use of this soil. (Capability unit IIw-4)

Bonpas silty clay loam (Bo).—This nearly level soil has the profile described as typical for the series. The surface layer is sticky when wet and must be cultivated within a narrow range of moisture content. Otherwise, surface clodding is a hazard to seedlings. Even after artificial drainage, wetness limits the use of this soil. (Capability unit IIw-4)

Brookston Series

The Brookston series consists of very poorly drained soils that are deep and dark colored. These soils are nearly level or in depressions. They have formed in calcareous loam till that in some places is mantled with loess. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Brookston soil has a surface layer of black silty clay loam 10 inches or more thick. The upper subsoil layers are mostly dark-gray or gray silty clay. They are mottled with yellowish brown and have a few very dark gray streaks. The lower subsoil layers are mottled, olive-gray and yellowish-brown silty clay loam and clay loam. Below a depth of 27 inches is calcareous loam till.

The Brookston soils are moderately slowly permeable, and they have a high organic-matter content and high available moisture capacity. Surface ponding and seasonal wetness are the major limitations.

The Brookston soils are suited to most cultivated crops, but adequate drainage is needed. Crops respond well to fertilizer.

Technical description of a profile of Brookston silty clay loam in a meadow in Harrison Township, NE $\frac{1}{4}$ sec. 2, T. 7 N., R. 3 E.:

Ap—0 to 7 inches, black (10YR 2/1) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; slightly acid; lower boundary clear and smooth.

- A1—7 to 10 inches, black (10YR 2/1) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; slightly acid; lower boundary abrupt and smooth.
- B21tg—10 to 13 inches, dark-gray (10YR 4/1) and gray (10YR 5/1) silty clay; common, fine and medium, distinct yellowish-brown (10YR 5/4) mottles; few very dark gray (10YR 3/1) streaks less than 20 millimeters wide; moderate, medium, angular and subangular blocky structure; firm; neutral; lower boundary clear and smooth.
- B22tg—13 to 17 inches, gray (5Y 5/1) silty clay; common, fine and medium, prominent, yellowish-brown (10YR 5/6) mottles; few very dark gray (10YR 3/1) streaks less than 20 millimeters wide; strong, medium, angular blocky structure; firm; neutral; lower boundary clear and smooth.
- B23tg—17 to 23 inches, olive-gray (5Y 5/2) silty clay loam; common, medium, prominent, yellowish-brown (10YR 5/6) mottles; few very dark gray (10YR 3/1) streaks less than 15 millimeters wide; weak, medium, prismatic structure that breaks to strong, medium and coarse, angular blocky; firm; neutral; lower boundary clear and smooth.
- B3g—23 to 27 inches, yellowish-brown (10YR 5/6) clay loam; common, medium, distinct, gray (5Y 5/1) and dark-gray (5Y 4/1) mottles; few very dark gray (10YR 3/1) crayfish hole fillings; moderate, medium, angular and subangular blocky structure; friable; calcareous; lower boundary clear and wavy.
- C1g—27 to 36 inches, loam till that has intermingled colors of gray (5Y 5/1), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6); weak, fine, subangular blocky structure; friable; strongly calcareous; lower boundary gradual and smooth.
- C2g—36 to 46 inches, calcareous loam till that has intermingled colors of gray (5Y 5/1), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6); weak, fine, subangular blocky structure; the gray color is mostly in seams or streaks.
- C3g—46 to 54 inches, calcareous loam till that has intermingled colors of gray (5Y 5/1), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6); massive; the gray color is mostly in seams or streaks.
- C4g—54 to 64 inches, calcareous loam till that has intermingled colors of gray (5Y 5/1) and dark yellowish-brown (10YR 5/6); massive; the gray color is mostly in seams or streaks.

The total thickness of the A horizons ranges from 8 to 14 inches. Soils with both silt loam and silty clay loam texture in the surface layer have been mapped in Preble County.

The thickness of the solum is generally about 45 inches, but the range is from 25 to 60 inches. The solum is thickest where these soils are near soils of the Russell drainage sequence and thinnest where they are near soils of the Miami drainage sequence.

Adjacent to or near the Brookston soils are the Russell, Miami, Lewisburg, and Pymont soils. The Brookston soils are more poorly drained and have a darker surface layer than these soils.

Brookston silt loam, 0 to 2 percent slopes (BrA).—This soil lies in and along shallow drainageways and along the outer edges of large depressional areas of Brookston silty clay loam, 0 to 2 percent slopes.

Included with this soil are some areas of somewhat poorly drained soils and spots of Brookston silty clay loam, 0 to 2 percent slopes.

Brookston silt loam, 0 to 2 percent slopes, has a moderately deep to deep root zone and has good tilth if tilled at the proper moisture content. Where it occurs in the boulder belt, installation of tile drainage is difficult because, even though boulders may have been removed from the plow layer, many boulders occur at lower depths. (Capability unit IIw-4)

Brookston silty clay loam, 0 to 2 percent slopes (BsA).—This soil lies in broad depressions and in drainageways.

Included with this soil are a few areas of somewhat poorly drained soils and spots of Brookston silt loam, 0 to 2 percent slopes, that are too small to be shown separately on the soil map. Also included are areas that have a thicker surface layer and a grayer upper subsoil than is typical for the Brookston series. In addition, there are areas that are shallower (16 to 25 inches) to calcareous materials; these areas occur mostly in and north of the boulder belt shown on the general soil map.

This Brookston soil has a moderately deep to deep root zone. It has good tilth if tilled at the proper time, but it is more likely to be cloddy than Brookston silt loam, 0 to 2 percent slopes. Where this soil is within the boulder belt, installation of the drainage is difficult because, even though boulders may have been removed from the plow layer, many boulders occur at lower depths. (Capability unit IIw-4)

Casco Series

The Casco series consists of deep, well-drained, steep to very steep soils formed in loam or sandy loam outwash material that overlies stratified calcareous sand and gravel. These soils occupy terraces, sides of outwash valleys, and kames.

The surface layer of a typical moderately eroded Casco soil is dark grayish-brown clay loam about 5 inches thick. The subsoil, to a depth of about 19 inches, is dark reddish-brown and dark-brown clay loam. Below this layer there is stratified calcareous sand and gravel.

The surface layer has a low organic-matter content, particularly in eroded areas. The subsoil has moderate permeability. The substratum has rapid permeability and good natural drainage. The root zone is limited in depth by the gravelly and sandy substratum, and it has low available moisture capacity.

Most of the acreage of the Casco soils is used for permanent pasture and woodland. Steepness of slope, a hazard of erosion, and low available moisture capacity limit the use of these soils.

Technical description of a profile of Casco clay loam in a moderately eroded pasture in Lanier Township, sec. 36, T. 5 N., R. 3 E.:

- A1—0 to 5 inches, dark grayish-brown (10YR 4/2) clay loam; weak, medium, subangular blocky structure; friable; neutral; lower boundary abrupt and smooth.
- B2t—5 to 12 inches, dark reddish-brown (5YR 3/4) clay loam; weak, coarse, subangular blocky structure; firm; neutral; lower boundary clear and smooth.
- B3—12 to 19 inches, clay loam that is dark brown (7.5YR 4/4) when crushed; weak, fine, subangular blocky structure; firm; neutral but weakly calcareous in lower part; lower boundary clear and smooth.
- IIC—19 inches +, loamy sand and gravel that is dark brown (7.5YR 4/4) when crushed; structureless; strongly calcareous.

The A horizon of these soils ranges in texture from clay loam to sandy loam. The thickness of the A horizon varies according to the past use of the soils.

The color of the B2t horizon ranges from dark brown (7.5YR 3/2 and 4/4) to dark reddish brown (5YR 3/2, 3/3, and 3/4). In areas that have not been cultivated, there commonly is a thin B1 horizon in the Casco soils in Preble County. The texture of the B3 horizon ranges from clay loam to gravelly clay loam or loam. From the lower part of the B3 horizon,

tongues extend into the IIC horizon to a depth of as much as 2 feet.

In this county the reaction of the entire solum is normally neutral or calcareous.

These soils are near areas of the Rodman and Fox soils. The Casco soils have a developed subsoil that is not present in the Rodman soils, but the Casco soils have a thinner subsoil than the Fox soils. The depth to sand and gravel in the Casco soils ranges from 10 to 24 inches, but in the Fox soils it ranges from 24 to 42 inches.

Casco, Rodman, and Fox soils, 18 to 25 percent slopes, moderately eroded (C_cF2).—Areas of this mapping unit have one, two, or all three of these soils. These soils have been mapped in an undifferentiated soil group because suitable management and use are similar.

Part of the surface layer of the soils in this unit has been removed by erosion. Surface runoff is very rapid, and the soils are highly susceptible to further erosion if adequate vegetation is not maintained.

Some severely eroded areas have been included in this mapping unit. These areas have the same limitations as the moderately eroded areas, except that they have very low available moisture capacity. In addition, they are a source of siltation. (Capability unit VIIIs-1)

Casco, Rodman, and Fox soils, 25 to 50 percent slopes, moderately eroded (C_cF2).—Areas of this mapping unit have one, two, or all three of these soils. Suitable management and use of the soils are the same.

Erosion has removed part of the surface layer of the soils. The available moisture capacity and the organic-matter content are low. Surface runoff is very rapid, and the soils are highly susceptible to further erosion if not protected by an adequate cover of vegetation. (Capability unit VIIIs-1)

Casco, Rodman, and Fox soils, 25 to 50 percent slopes, severely eroded (C_cF3).—Areas of this mapping unit have one, two, or all three of these soils. Suitable management and use are the same for these soils.

Erosion has removed most of the upper soil layers, and sandy gravel is exposed over much of the area. As a result, the available moisture capacity is very low and the organic-matter content is low. Surface runoff is very rapid, and the soils are very highly susceptible to further erosion. (Capability unit VIIIs-1)

Celina Series

The Celina series consists of deep, moderately well drained soils. These nearly level to sloping soils have formed in calcareous loam till, but in places the till is covered by as much as 18 inches of wind-deposited silty material. The soils occur in most parts of the county. The native vegetation was a mixed stand of deciduous hardwood trees.

A typical cultivated Celina soil has a friable, dark-gray silt loam surface layer. Below this is a thin transitional layer of dark yellowish-brown clay loam. The subsoil is dark brown or dark yellowish brown and is clayey enough to restrict internal movement of water. It is mottled with faint yellowish brown. Starting at a depth of 18 inches and continuing to a depth of about 29 inches is yellowish-brown clay loam. Below a depth of about 29 inches is yellowish-brown loam that is strongly calcareous.

The Celina soils have a seasonal high water table, and they are moderately slowly permeable. They are mostly neutral or mildly alkaline in reaction.

The Celina soils are easy to cultivate and are suited to all crops commonly grown in the county. Crops respond well to fertilizer.

Technical description of a profile of Celina silt loam in a cultivated field in Monroe Township, NE $\frac{1}{4}$ sec. 10, T. 9 N., R. 2 E. (Sample PB-59 in laboratory analyses):

- Ap—0 to 7 inches, dark-gray (10YR 4/1) silt loam; weak, medium, granular structure; friable; neutral; abrupt, smooth lower boundary.
- B1—7 to 9 inches, dark yellowish-brown (10YR 4/4) clay loam; thin, continuous, grayish-brown (10YR 5/2) clay coatings and some dark-gray (10YR 4/1) fillings in root channel; moderate, medium, subangular blocky structure; friable; neutral; clear, smooth lower boundary.
- B21t—9 to 12 inches, dark-brown (10YR 4/3) clay; thin, continuous, dark grayish-brown (10YR 4/2) clay coatings and few, fine, faint, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; neutral; gradual, diffuse lower boundary.
- B22t—12 to 18 inches, mixed dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) clay; thin, continuous, dark grayish-brown (10YR 4/2) clay coatings; moderate, medium, subangular and angular blocky structure; firm, mildly alkaline; clear, irregular lower boundary.
- B3t—18 to 24 inches, yellowish-brown, mixed (10YR 5/4 and 5/6) clay loam; thin, continuous, dark grayish-brown (10YR 4/2) clay coatings; weak, medium, subangular blocky structure; friable; slightly calcareous; diffuse lower boundary.
- C1—24 to 29 inches, yellowish-brown, mixed (10YR 5/4 and 5/6) clay loam; grayish-brown (10YR 5/2) seams and some thin, discontinuous, dark grayish-brown (10YR 4/2) clay coatings; weak subangular blocky structure; friable; calcareous; diffuse lower boundary.
- C2—29 to 60 inches, yellowish-brown (10YR 5/4) loam that has gray (10YR 6/1) seams; massive; friable; strongly calcareous till.

Most areas of these soils have a covering of loess that ranges up to 18 inches in thickness. The depth to calcareous material is 18 to 27 inches in most places, but the range is 18 to 36 inches. In the area of the boulder belt, boulders are common on the surface and throughout the solum.

The Celina soils are adjacent to the Miami, Corwin, Crosby, Odell, and Brookston soils. They are lighter colored than the Corwin, Odell, and Brookston soils. They are better drained than the Crosby soils, and they are more poorly drained than the Miami soils.

Celina bouldery silt loam, 2 to 6 percent slopes (CbB).—This soil is on ridgetops and low knolls and along drainageways. It occurs in the boulder belt shown on the general soil map, and boulders are so numerous in the plow layer that they seriously restrict the use of modern farm machinery.

This soil has medium available moisture capacity, a medium content of organic matter, and a moderately deep root zone. It is susceptible to erosion when cultivated. (Capability unit IIe-1)

Celina silt loam, 0 to 2 percent slopes (CeA).—This soil is at the top of slopes, along streambanks, and along drainageways.

Included with this soil are small areas of somewhat poorly drained Crosby soils that are too small to be shown separately on the soil map. These included soils have more distinct mottling than this Celina soil, and the mottles are near the surface.

This Celina soil has medium available moisture capacity and a moderately deep root zone. It has good tilth and a

medium content of organic matter. There is little or no hazard of erosion. (Capability unit I-1)

Celina silt loam, 2 to 6 percent slopes (CeB).—This soil occupies low knolls, ridgetops, and areas that border drainage ways. It has medium available moisture capacity and a moderately deep root zone. It has good tilth and medium organic-matter content.

If this soil is cultivated, erosion is a hazard, especially on the higher slopes. (Capability unit IIe-1)

Celina silt loam, 2 to 6 percent slopes, moderately eroded (CeB2).—This soil is on low knolls, ridgetops, and areas that border drainage ways. It occurs south and west of the boulder belt shown on the general soil map.

Part of the original plow layer of this soil has been removed by erosion. About 50 percent of the present plow layer consists of former subsoil. This soil has fair tilth, but the organic-matter content is low. The available moisture capacity is medium. The root zone is moderately deep.

Surface runoff is medium, and erosion is a moderate hazard when this soil is cultivated. (Capability unit IIe-1)

Celina-Miami silt loams, 6 to 12 percent slopes, moderately eroded (CmC2).—These soils lie on hillsides and high knolls. Part of the original plow layer of these soils has been removed by erosion. About 50 percent of the present plow layer consists of former subsoil.

These soils have fair tilth and moderate available moisture capacity. The organic-matter content is low. The root zone is moderately deep. Surface runoff is rapid, and susceptibility to further erosion is moderate to high. (Capability unit IIIe-1)

Channahon Series

The soils in the Channahon series are well drained and dark colored. They have formed from thin, calcareous glacial till and outwash deposits underlain by limestone bedrock. The native vegetation was a mixed stand of prairie grasses and scattered deciduous hardwoods.

A typical Channahon soil has a thin surface layer that is very dark grayish-brown silt loam. The subsoil in the upper part is dark-brown silt loam or silty clay loam. In the lower part it is very dark grayish-brown or olive-brown silty clay. Fractured limestone bedrock begins 18 to 20 inches from the surface.

Because they are shallow to bedrock, the Channahon soils have low available moisture capacity and a limited root zone. The surface layer has a high organic-matter content.

Technical description of a profile of Channahon silt loam in Lanier Township, SW $\frac{1}{4}$ sec. 15, T. 5 N., R. 3 E.:

- A—0 to 3 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; moderate, fine and medium, granular structure; friable; neutral; abrupt, smooth lower boundary.
- B1—3 to 7 inches, dark-brown (10YR 3/3) heavy silt loam; weak, medium, subangular blocky structure; friable; neutral; clear, smooth lower boundary.
- B21t—7 to 12 inches, dark-brown (10YR 3/3) silty clay loam, continuous, very dark grayish-brown (10YR 3/2) ped coatings; moderate, medium, subangular blocky structure; friable; some till pebbles; neutral; clear, smooth lower boundary.
- B22t—12 to 17 inches, very dark grayish-brown (10YR 3.5/2) silty clay; moderate, fine and medium, subangular blocky structure; firm; neutral; clear, smooth lower boundary.
- IIB23—17 to 18 inches, olive-brown (2.5Y 4/4) silty clay; moderate, fine, subangular blocky structure; firm; mildly alkaline; abrupt, smooth lower boundary.

R—18 inches +, fractured limestone bedrock.

The thickness of the solum and the depth to bedrock, which are identical, range from 10 to 20 inches. The upper part of the solum is generally neutral to slightly acid, but in places it is medium acid. The lower part of the solum is neutral to slightly calcareous.

The color of the A horizon varies in that the 10YR hue has values of 2 or 3 and chromas of 1 to 3. The B horizon has hues of 7.5YR or 10YR, values of 3 or 4, and chromas of 2 or 3.

The texture of the B2 horizon is silty clay loam, heavy clay loam, silty clay, or clay.

The Channahon soils are darker colored than the Ritchey soils. They have fewer slabs of limestone in the surface layer and subsoil than the Fairmount soils, which have formed in weathered limestone and shale.

Channahon and Fairmount soils, 18 to 25 percent slopes, moderately eroded (CnE2).—Areas of this undifferentiated soil group have one or both soils in various amounts and patterns. Because of erosion, only 2 or 3 inches of the original surface layer remains. The available moisture capacity is very low, and the root zone is shallow to very shallow. Surface runoff is very rapid, and the hazard of further erosion is very high if the permanent vegetation is removed. (Capability unit VIe-1)

Corwin Series

The Corwin series consists of deep, dark-colored, nearly level to gently sloping soils that are moderately well drained. These soils occur on uplands. They have formed in calcareous loam till. In places the upper part of the soil profile has formed in wind-deposited material (loess) that is as much as 18 inches thick. The native vegetation was mixed prairie grasses and scattered deciduous hardwoods.

The plow layer of a typical Corwin soil, to a depth of 7 inches, is very dark grayish-brown silt loam. Below the plow layer is very dark brown silt loam to a depth of 10 inches. The subsoil, to a depth of about 28 inches, is characterized by brownish colors and clay loam texture. The substratum is calcareous loam till of Wisconsin glacial age.

Both the organic-matter content and available moisture capacity are high. Permeability is moderately slow. Grayish mottling in the subsoil indicates a seasonal high water table. The root zone is deep to moderately deep.

Most of the acreage of the Corwin soils is cultivated. Corn, soybeans, wheat, and other crops common to the county are grown. Crops respond well to fertilizer. Erosion, however, is a hazard on the gently sloping soils.

Technical description of a profile of Corwin silt loam, 2 to 6 percent slopes, in a cultivated field in Jackson Township, sec. 18, T. 8 N., R. 1 E. (Sample PB-39 in laboratory analyses):

- Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; strongly acid; lower boundary abrupt and smooth.
- A3—7 to 10 inches, very dark brown (10YR 2/2) silt loam; very dark grayish brown (10YR 3/2) when crushed; moderate, medium, granular structure; friable; strongly acid; lower boundary clear and smooth.
- B1—10 to 14 inches, dark-brown (10YR 3/3) silt loam; very dark brown (10YR 2/2), discontinuous clay coatings on ped surfaces; weak, fine and medium, subangular blocky structure; firm; medium acid; lower boundary clear and smooth.
- B21t—14 to 18 inches, brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) clay loam; very dark grayish-brown (10YR 3/2) and brown (10YR 4/3), thin clay coatings on ped surfaces; weak, fine and medium, sub-

- angular blocky structure; firm; medium acid; lower boundary diffuse.
- IIB22t—18 to 22 inches, brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) clay loam; very dark grayish-brown (10YR 3/2) and brown (10YR 4/3), thick clay coatings on ped surfaces; moderate, medium, angular and subangular blocky structure; firm; slightly acid; lower boundary diffuse.
- IIB23t—22 to 25 inches, brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) clay loam; brown (10YR 4/3) and some very dark grayish-brown (10YR 3/2) clay coatings on ped surfaces; moderate, coarse, subangular blocky structure; firm; neutral; lower boundary diffuse.
- IIB3—25 to 28 inches, brown (10YR 4/3) clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/4) mottles and few, discontinuous, very dark grayish-brown (10YR 3/2) clay coatings on ped surfaces; weak, coarse, subangular blocky structure; friable; lower boundary abrupt and wavy. (This horizon has been partly leached and has intermittent pockets of calcareous till throughout.)
- IIC1—28 to 34 inches, dark yellowish-brown (10YR 4/4) loam; some dark-brown (10YR 3/3) clay in vertical seams; massive; friable; calcareous; lower boundary diffuse.
- IIC2—34 to 40 inches, brown (10YR 4/3) and yellowish-brown (10YR 5/4) loam with some dark-brown (10YR 3/3) clay in vertical seams; massive; friable; strongly calcareous; lower boundary diffuse.
- IIC3—40 to 50 inches, yellowish-brown (10YR 5/4) sandy loam; massive; friable; slightly calcareous.
- IIC4—50 to 60 inches, grayish-brown (10YR 5/2), yellowish-brown (10YR 5/4) and 5/6, and dark yellowish-brown (10YR 4/4) loam; massive; friable; strongly calcareous.

The color of the A horizon ranges from very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2). The A horizon ranges from strongly acid to slightly acid, and the B horizon ranges from medium acid to neutral. Faint to distinct mottling occurs at depths below 18 to 25 inches. The depth to calcareous loam till is most commonly about 32 inches, but the range is from 19 to 44 inches.

The Corwin soils are near soils in the Miami, Celina, Crosby, and Brookston drainage sequence. The surface layer of the Corwin soils is darker colored than that of the Miami, Celina, and Crosby soils. The Corwin soils have better natural drainage than the Brookston and Crosby soils. They are similar to the Dana soils, except for having formed in a thinner capping of loess.

Corwin silt loam, 0 to 2 percent slopes (CoA).—This soil occurs between the Brookston soils in the depressions and drainageways and the Celina soils on the slightly higher areas.

Included with this soil are some areas of the moderately well drained Celina soils that are too small to be shown separately on the soil map.

Surface runoff of this Corwin soil is medium to slow, and erosion is not a hazard. Where this soil is in the boulder belt shown on the general soil map, most of the boulders have been cleared from the plow layer. Even so, a few boulders are plowed up each year and have to be removed for efficient use of modern farming equipment. (Capability unit I-1)

Corwin silt loam, 2 to 6 percent slopes (CoB).—This soil occurs between the Brookston soils in the depressions and drainageways and the Celina and Miami soils on the slightly higher areas.

Included with this soil are a few areas of the moderately well drained Celina soils that are too small to be shown separately on the soil map.

Surface runoff from this Corwin soil is medium, and both runoff and erosion need to be controlled. Where this soil is in the boulder belt shown on the general soil map,

most of the boulders have been cleared from the plow layer. Even so, a few boulders are plowed up each year and have to be removed for efficient use of modern farming equipment. (Capability unit IIe-1)

Crane Series

The Crane series consists of somewhat poorly drained, dark-colored, nearly level soils formed in a thin layer of loess underlain by silty and loamy outwash material. The substratum is stratified calcareous sand and gravel. These soils occupy stream terraces. The native vegetation was mixed prairie grasses and scattered deciduous hardwoods.

The friable silt loam plow layer is very dark grayish brown. The subsoil is very dark gray silty clay loam in the upper part; at a depth of about 21 inches, there is brown clay loam distinctly mottled with yellowish brown. Stratified calcareous sand and gravel occur at a depth of about 42 inches.

These soils have high organic-matter content. The subsoil has moderate permeability. A seasonal high water table causes somewhat poor drainage. When the soils are drained, the root zone has high available moisture capacity. Crops respond well to fertilizer and improved drainage.

Most of the acreage of these soils is used for crops, mainly corn, soybeans, wheat, and hay. Wetness is a limitation, however.

Technical description of a profile of Crane silt loam in a cultivated field in Washington Township, sec. 9, T. 8 N., R. 2 E.:

- Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, granular structure; friable; neutral; lower boundary abrupt and smooth.
- A1—7 to 11 inches, very dark gray (10YR 3/1) silt loam; moderate, very fine, subangular blocky structure; friable; neutral; lower boundary clear and smooth.
- B21—11 to 21 inches, very dark gray (10YR 3/1) silty clay loam; common, fine, distinct, dark grayish-brown and yellowish-brown (10YR 4/2 and 5/4) mottles; strong, fine, angular and subangular blocky structure; friable; neutral; lower boundary gradual and smooth.
- B22tg—21 to 26 inches, brown (10YR 4/3) clay loam; very dark gray (10YR 3/1) coatings on ped surfaces and common, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; moderate, medium, subangular blocky structure; firm; neutral; lower boundary clear and smooth.
- B23tg—26 to 32 inches, dark grayish-brown (10YR 4/2) clay loam mottled with yellowish brown (10YR 5/6); weak, medium, subangular blocky structure; firm; slightly calcareous.
- IIB3—32 to 42 inches, yellowish-brown (10YR 5/6 and 5/8) and dark grayish-brown (10YR 4/2) loam; weak, medium, subangular blocky structure; calcareous; contains limestone fragments.
- IIC—42 to 60 inches, loose sand and gravel; calcareous.

The color of the A horizon ranges from very dark grayish brown (10YR 3/2) to black (10YR 2/1). The reaction ranges from medium acid to neutral.

The texture of the IIB3 horizon varies; loam and sandy loam are most common. Gleyed coatings on ped surfaces in the B horizon have chromas of 2 or less and range in value from 3 to 5. Brown or yellowish-brown mottles occur below depths of 10 to 15 inches.

Depth to loose sand and gravel ranges from 42 to 65 inches, but most commonly this material begins at the shallower end of this range.

These soils are near the Wea, Tippecanoe, Westland, Thacker, and Sleeth soils. The Crane soils are similar to the Sleeth soils but have a darker colored surface layer.

Crane silt loam (Cr).—This nearly level soil occurs on outwash plains and also on outwash valley terraces near the breaks to the uplands.

Included with this soil are some areas of Westland soils that are too small to be shown separately on the soil map. Also included are areas that are underlain at a depth of about 37 inches by sandy loam or loam instead of sand and gravel. These areas generally occur where this soil borders the uplands.

Wetness limits the use of Crane silt loam, unless it has been artificially drained. (Capability unit IIw-2)

Crosby Series

The Crosby series consists of nearly level to gently sloping, somewhat poorly drained soils formed from calcareous loam till or from calcareous loam till overlain by as much as 18 inches of silty wind-deposited material. The soils are fairly extensive throughout the county.

A typical cultivated Crosby soil consists of dark grayish-brown silt loam to a depth of 10 inches. Thin subsoil layers, at depths of from 10 to about 20 inches, have more clay than the layers above. These subsoil layers consist mainly of yellowish-brown silty clay loam. Below a depth of 24 inches is calcareous, yellowish-brown loam till. The till is firm and compact, and it restricts movement of water and penetration of roots.

The Crosby soils have medium to high available moisture capacity. They have low to medium organic-matter content and generally have a high water table during winter and spring. They are slowly permeable.

Where Crosby soils are cultivated, they need artificial drainage for maximum production of crops. These wet soils dry out and warm up later in spring than the adjacent Miami and Celina soils. Good tilth is difficult to obtain if Crosby soils are tilled when wet. Crops respond well to lime and fertilizer, however.

Technical description of a profile of Crosby silt loam in a cultivated field in Washington Township, SW $\frac{1}{4}$ sec. 2, T. 8 N., R. 2 E. (Sample PB-2 in laboratory analyses):

- Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, slightly lighter color when crushed; grayish brown (10YR 5/2) when dry; very weak, fine, crumb structure; friable; neutral.
- B1—7 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; many, medium, prominent, yellowish-brown (10YR 5/4 and 10YR 5/6) mottles; moderate, medium, sub-angular blocky structure; firm; neutral.
- B21tg—10 to 14 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, prominent, grayish-brown (10YR 5/2) mottles and many dark grayish-brown (10YR 4/2) coatings on peds; strong, medium, angular blocky structure; very firm; neutral.
- B22tg—14 to 17 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, prominent, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles and many, medium, prominent, grayish-brown (10YR 5/2) mottles; dark grayish-brown (10YR 4/2) coatings on peds; strong, medium, angular blocky structure; very firm; neutral.
- B23tg—17 to 20 inches, yellowish-brown (10YR 5/4) silty clay; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles and many, medium, prominent, grayish-brown (10YR 5/2) mottles; very dark grayish-brown (10YR 3/2) and dark-gray (10YR 4/1) coatings on peds, thinner than those in the B22tg horizon; strong, medium and coarse, angular blocky structure; very firm; neutral.

B3g—20 to 24 inches, yellowish-brown (10YR 5/4) loam; many, medium, prominent, grayish-brown (10YR 5/2) and dark yellowish-brown (10YR 4/4) mottles; common dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) coatings on peds; weak, coarse, angular blocky structure; firm in place, friable when removed; calcareous.

C1—24 to 29 inches, yellowish-brown (10YR 5/4) loam; common, medium, prominent, yellowish-brown (10YR 5/6) and grayish-brown (10YR 5/2) mottles; light-gray (10YR 6/1) seams of lime; massive; very firm in place, friable when removed; calcareous.

C2—29 to 34 inches, yellowish-brown (10YR 5/4) loam; common, medium, prominent, light-gray (10YR 6/1) mottles; massive; very firm in place, friable when removed; calcareous.

C3—34 to 60 inches, dark yellowish-brown (10YR 4/4) loam; few, medium, prominent, light-gray (10YR 6/1) mottles; massive; very firm in place, friable when removed; calcareous till.

The color of the surface layer ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The depth to mottling ranges from 4 to about 14 inches. Depth to calcareous loam till ranges from 18 to 40 inches. The texture of the B horizon varies; textures include silty clay loam, clay loam, and clay.

The Crosby soils are more poorly drained than the adjacent Miami and Celina soils but better drained than the adjacent Brookston soils. They are deeper to calcareous till material than the Pymont soils, and they have a thinner layer of wind-deposited material over the till than the Fincastle soils.

Crosby bouldery silt loam, 0 to 2 percent slopes (CsA).—This nearly level soil is on broad areas between drainageways and in areas surrounding Brookston soils that are in depressions. It occurs in the boulder belt shown on the general soil map.

The profile of this soil differs somewhat from that of the Crosby silt loam just described as representative for the series. It is normally a little shallower to calcareous loam till.

Included with this soil are some areas of very poorly drained, dark-colored Brookston soils that are too small to be shown separately on the soil map.

This Crosby soil is somewhat poorly drained, and drainage is needed for maximum production of cultivated crops. The many boulders on the surface and throughout the profile make installation of tile drainage difficult and restrict the use of farm machinery. (Capability unit IIw-2)

Crosby bouldery silt loam, 2 to 6 percent slopes (CsB).—This soil is on low knolls, on long, gentle slopes, and around drainageways. It occurs in the boulder belt shown on the general soil map.

The profile of this soil differs somewhat from that of the Crosby silt loam described as representative for the series. It normally is a little shallower to calcareous loam till.

Included with this soil are some areas of moderately well drained Celina soils that are too small to be shown separately on the soil map. The Celina soils generally do not need artificial drainage.

This Crosby soil is somewhat poorly drained, and artificial drainage is needed for maximum production of cultivated crops. The many boulders on and throughout the soil make installation of tile drainage difficult and restrict the use of farm machinery. If the soil is cleared of boulders, however, wetness is still a problem. (Capability unit IIw-2)

Crosby silt loam, 0 to 2 percent slopes (CtA).—This nearly level soil occurs in broad areas between drainageways and in areas surrounding Brookston soils of the depressions.

Included with this soil are some areas of very poorly drained, dark-colored Brookston soils that are too small to be shown separately on the soil map. Seasonal wetness hinders crop production unless this soil is artificially drained. (Capability unit IIw-2)

Crosby-Celina silt loams, 2 to 6 percent slopes (CyB).—

The soils of this complex are near drainageways and on gentle slopes around depressions. The Crosby soils in this complex occupy nearly twice as much acreage as the Celina soils, but the random pattern in which the two soils occur makes it difficult to separate them at the scale of mapping used. The Crosby soils are in the lower, flatter areas, and the Celina soils are on the higher, more sloping areas.

The Crosby soils are wet and need to be drained, but the Celina soils normally do not need to be drained. (Capability unit IIw-2)

Dana Series

The Dana series consists of deep, dark-colored, nearly level to gently sloping soils that are moderately well drained. The soils have formed in silt-mantled, calcareous loam till. They are located in Israel, Dixon, Somers, and Jackson Townships. Also, there are a few areas of Dana soils in the southwestern corner of Gratis Township. The native vegetation was mixed prairie grasses and scattered deciduous hardwood forests.

The plow layer of a typical Dana soil is very dark brown, friable silt loam. The subsoil, to a depth of about 29 inches, is silty clay loam characterized by brownish colors. The calcareous substratum is massive till of loam and sandy loam texture.

The surface layer has high organic-matter content. The root zone is deep, and the available moisture capacity is high. Permeability is moderately slow. Crops respond well to fertilizer.

Most of the acreage of the Dana soils is farmed. Corn, wheat, and soybeans, the main crops, are grown along with other crops common to the area.

Technical description of a profile of Dana silt loam, 2 to 6 percent slopes, in a recently reforested field (formerly cultivated) in Israel Township, sec. 35, T. 6 N., R. 1 E. (Sample PB-36 in laboratory analyses):

- Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam; weak, fine, subangular blocky structure that breaks to moderate, medium, crumb; friable; medium acid; lower boundary abrupt and smooth.
- A1—7 to 9 inches, very dark brown (10YR 2/2) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; medium acid; lower boundary abrupt and smooth.
- B1—9 to 12 inches, brown (10YR 4/3) coarse silty clay loam; very dark gray (10YR 3/1) coatings on ped surfaces; moderate, fine and medium, angular blocky structure; friable; medium acid; lower boundary clear and smooth.
- B21t—12 to 18 inches, brown (10YR 4/3) coarse silty clay loam; very dark grayish-brown (10YR 3/2) coatings on ped surfaces; moderate, medium, angular blocky structure; friable; slightly acid; lower boundary diffuse.
- B22t—18 to 23 inches, dark yellowish-brown (10YR 4/4) coarse silty clay loam; dark grayish-brown (10YR 4/2) and very dark grayish brown (10YR 3/2) coatings on ped surfaces; moderate, medium, angular and subangular blocky structure; friable; slightly acid; lower boundary clear and smooth.
- B31—23 to 29 inches, yellowish-brown (10YR 5/4) silty clay loam; few, fine, faint, yellowish-brown (10YR 5/8)

mottles; dark grayish-brown (10YR 4/2) and very dark grayish-brown (10YR 3/2) coatings on the ped surfaces; moderate, medium and coarse, angular blocky structure; friable; neutral; lower boundary diffuse.

- B32—29 to 34 inches, yellowish-brown (10YR 5/6) silt loam; few, fine, faint, yellowish-brown (10YR 5/8) mottles; few dark grayish-brown (10YR 4/2) ped coatings and few very dark grayish-brown (10YR 3/2) fillings in root channels; weak, medium, subangular blocky structure; friable; neutral; boundary between silt capping and till clear and smooth.
- IIB33—34 to 40 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, faint, yellowish-brown (10YR 5/6) mottles; few very dark grayish-brown (10YR 3/2) fillings in root channels; massive; friable; weathered limestone fragments and pebbles; calcareous; lower boundary clear and smooth.
- IIIC1—40 to 46 inches, brown (10YR 4/3) sandy loam till; massive; calcareous.
- IIIC2—46 to 54 inches, yellowish-brown (10YR 5/4) sandy loam; blotches of dark grayish brown (10YR 4/2); calcareous.
- IVC3—54 to 63 inches, yellowish-brown (10YR 5/4) loam containing pockets of compact silt; calcareous.

The thickness of the silt mantle ranges from 18 to 40 inches. The depth to mottling ranges from about 20 to 30 inches. The color of the A horizon ranges from very dark brown (10YR 2/2) to dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2). The organic-matter content is greatest in the A horizon, or 3.5 to 4.5 percent, and decreases to about 1 percent at a depth of 20 inches.

The Dana soils are most acid in the Ap horizon, where the range is strongly acid to medium acid. The pH values increase with greater depth in the solum.

The Dana soils have a darker colored surface layer than the Xenia soils and better natural drainage than the Fincastle, Brookston, and Raub soils. Dana soils have a thicker mantle of loess (more than 18 inches) overlying the till substratum than do the Corwin soils. They are adjacent to Corwin soils in many places.

Dana silt loam, 0 to 2 percent slopes (DaA).—This soil occurs between the Brookston soils in depressions and the Russell soils on the adjacent slopes.

Included with this soil are some areas of somewhat poorly drained Raub soils that are too small to be shown separately on the soil map. Also included are small areas where the silt capping is more than 42 inches thick.

Surface runoff from this Dana soil is medium to slow. There is little or no risk of erosion. (Capability unit I-1)

Dana silt loam, 2 to 6 percent slopes (DaB).—A profile of this soil is described as representative of the series. The soil occurs on the lower ends of long, gentle slopes.

Included with this soil are a few areas of somewhat poorly drained Raub soils that are too small to be shown separately on the soil map. Also included are small areas where the silt capping is more than 42 inches thick.

Surface runoff from this Dana soil is medium. Erosion is a hazard if the soil is cultivated. (Capability unit IIe-1)

Fairmount Series

The Fairmount series consists of well-drained, shallow, very steep soils formed in fine-textured material weathered from thin-bedded limestone (fig. 5) and calcareous clay shale. These soils are on side slopes along drainageways in the uplands. The native vegetation was a mixed stand of oak, hickory, and other deciduous hardwoods.

The surface layer of a typical wooded soil is about 4 to 6 inches thick. It consists of very dark brown, firm silty clay



Figure 5.—A wooded area of Fairmount soils, which are shallow over limestone of Ordovician age.

loam. The subsoil, which extends to a depth of about 10 inches, is firm silty clay characterized by brown colors. Unconsolidated bedrock, mixed with some soil material, underlies the subsoil. Limestone flags occur throughout the surface layer and subsoil and make up about 3 to 15 percent of the soil.

Where uneroded, these soils have a medium to high organic-matter content in the surface layer. The root zone is shallow to very shallow. The available moisture capacity is very low, and permeability is moderately slow.

The Fairmount soils are seldom cultivated, because of their shallowness and limited capacity to hold moisture. Most of the acreage is used for pasture or woodland. Erosion is a serious problem if a good vegetative cover is not maintained.

Technical description of a profile of a very steep, uneroded Fairmount silty clay loam on a wooded slope in Somers Township, sec. 28, T. 6 N., R. 2 E.:

- A—0 to 4 inches, very dark brown (10YR 2/2) silty clay loam; strong, fine, subangular blocky structure; firm; slightly calcareous; a few limestone fragments; lower boundary clear and smooth.
- B—4 to 10 inches, dark-brown (10YR 4/3) silty clay; strong, medium, subangular blocky structure; firm; slightly calcareous; many limestone fragments.
- C—10 inches +, thin-bedded limestone and shale bedrock.

Depth to bedrock is fairly variable over short distances. It ranges from very shallow, around outcrops of rock, to a depth of about 20 inches.

The texture of the surface layer is predominantly silty clay loam. Where accelerated erosion has removed the original surface layer, the texture of the uppermost layer is silty clay.

The color of the surface layer ranges from very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2) and in a few places to dark brown (10YR 3/3). The B horizon has hues of 10YR and 2.5Y, chromas of from 2 to 4, and values of from 3 to 5.

The Fairmount soils are neutral to slightly calcareous throughout the profile.

The Fairmount soils are adjacent to the deeper Milton soils. Other nearby soils are the Russell, Kendallville, Miami, and Wynn.

Fairmount soils, 25 to 50 percent slopes, moderately eroded (FaF2).—This mapping unit includes both uneroded and moderately eroded soils. The profile described as typical for the series is that of an uneroded soil.

Included in this mapping unit are a few severely eroded areas and a few areas that have outcrops of bedrock.

The root zone is shallow to very shallow. It is particularly shallow in the few severely eroded areas. Surface runoff is very rapid, and the hazard of further erosion is very high. (Capability unit VIe-1)

Fincastle Series

The Fincastle series consists of somewhat poorly drained, nearly level to gently sloping soils formed in 18 to 40 inches of loess overlying loam till of the Wisconsin age. These soils occur on uplands south and west of the Camden moraine in Israel, Dixon, Somers, and Jackson Townships.

The dark grayish-brown plow layer of a typical Fincastle soil consists of friable silt loam. The subsoil, to a depth of about 36 inches, is silty clay loam. Characteristically, it is dark yellowish brown and yellowish brown to dark brown and has some gray mottles and coatings. The substratum is dark-brown loam till.

The surface layer of these soils has medium organic-matter content. Where drained, the soils have a deep root zone and high available moisture capacity. The subsoil is moderately slowly permeable.

Most of the acreage of the Fincastle soils is farmed. Corn, soybeans, wheat, and other crops common to the area grow well. Crops respond well to fertilizer. Because of a seasonal high water table, however, wetness is a hazard.

Technical description of a profile of Fincastle silt loam, 0 to 2 percent slopes, in a cultivated field in Israel Township, sec. 22, T. 6 N., R. 1 E.:

- Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, crumb structure; friable, nonsticky and nonplastic when wet; abundant roots; slightly acid; lower boundary abrupt.
- A2—8 to 11 inches, grayish-brown (10YR 5/2) silt loam; brown (10YR 4/3) when crushed; many, medium, prominent, dark yellowish-brown (10YR 4/4) mottles; very weak, fine and medium, subangular blocky structure; friable, nonsticky and nonplastic when wet; abundant roots; some soft, very dark brown concretions and stains of manganese throughout horizon; slightly acid; lower boundary clear.
- B1t—11 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky and

slightly plastic when wet; thin clay coatings on ped surfaces; few roots; neutral; lower boundary clear.

B21tg—14 to 19 inches, dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) silty clay loam; ped coatings are dark grayish brown (2.5Y 4/2); strong, medium, subangular blocky structure; firm, sticky and plastic when wet; dark grayish-brown clay films are thickest within this horizon; some till pebbles; few roots; neutral; lower boundary gradual.

B22tg—19 to 24 inches, dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) silty clay loam; ped coatings are dark grayish brown (2.5Y 4/2); clay coatings are thinner than those in the B21tg horizon; interior colors of peds show through these thinner clay coatings; strong, coarse, subangular blocky structure; firm, slightly sticky and plastic when wet; some manganese concretions; some till pebbles; few roots; neutral; lower boundary gradual.

B23tg—24 to 28 inches, dark yellowish-brown (10YR 4/4) to yellowish-brown (10YR 5/4) silty clay loam; very dark grayish-brown (2.5Y 3/2) coatings on peds, mainly on vertical surfaces; moderate, coarse, subangular blocky structure; few manganese concretions and stains; some till pebbles; few roots; neutral; lower boundary gradual.

B31t—28 to 32 inches, dark-brown (10YR 4/3) silty clay loam; very dark grayish-brown (10YR 3/2) coatings on peds, almost entirely on vertical surfaces; moderate, coarse, subangular blocky structure; neutral; lower boundary gradual.

IIB32t—32 to 36 inches, dark-brown (10YR 4/3) silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; thin dark-gray (10YR 4/1) clay films extend down into this horizon; weak subangular blocky structural fractures along clay coatings; massive in place; neutral; lower boundary clear and wavy.

IIC1—36 to 47 inches, dark-brown (10YR 4/3) loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; some clay films extend down into this horizon; massive; calcareous.

IIC2—47 to 67 inches, dark-brown (10YR 4/3) loam till; grayish-brown (10YR 5/2) streaks; massive, calcareous.

The reaction of the A horizon ranges from strongly acid to neutral, depending on past treatment of these soils. The reaction of the B horizon ranges from very strongly acid to neutral; the minimum pH normally occurs in the B1t or upper B2 horizons.

The color of the surface layer ranges from dark grayish brown (10YR 4/2) to dark brown (10YR 3/3).

The thickness of the layer of loess varies within short distances, but in most places it is about 28 inches. Where the loess is near the minimum thickness for soils of this series, the texture of the lower B horizon is normally clay loam. Depth to calcareous loam till ranges from 34 to 58 inches.

The soils in the drainage sequence with the Fincastle soils include the well drained Russell, moderately well drained Xenia, and very poorly drained Brookston.

Fincastle silt loam, 0 to 2 percent slopes (FcA).—This soil is on broad areas between drainageways and in strips around depressions.

Included with this soil are areas of very poorly drained Brookston soils that are too small to be shown separately on the soil map.

Wetness is the principal limitation to the use of this Fincastle soil. (Capability unit IIw-2)

Fincastle silt loam, 2 to 6 percent slopes (FcB).—This soil occurs on long slopes and around depressions and drainageways.

Included with this soil are areas of the moderately well drained Xenia soils that are too small to be shown separately on the soil map.

The major hazard of this Fincastle soil is wetness; however, erosion is a slight hazard. (Capability unit IIw-2)

Fox Series

The Fox series consists of well-drained soils formed in 24 to 42 inches of silty and loamy outwash material over stratified, calcareous sand and gravel. The silty material possibly represents deposits of loess. These soils occupy terraces and outwash plains. They are high enough above adjacent streams so that they are not subject to flooding.

The plow layer of a typical Fox loam is dark brown and friable. Below this, the upper part of the subsoil is reddish-brown and dark reddish-brown, firm clay loam. The lower part of the subsoil consists of firm clay that is neutral in reaction. The substratum is composed of stratified, calcareous sand and gravel.

Where the Fox soils are not severely eroded, the surface layer has a medium organic-matter content and the available moisture capacity is low to medium. Permeability is moderate in the subsoil. The root zone is moderately deep.

Most areas of the nearly level to sloping Fox soils are cropped. Corn, soybeans, wheat, and other crops are grown. Crops respond well to fertilizer. The soils, particularly those on the lesser slopes, are suitable for irrigation. The moderately steep soils and those mapped with Casco and Rodman soils are used for pasture and woodland.

Technical description of a profile of Fox loam, 0 to 2 percent slopes, in a cultivated field in Lanier Township, sec. 27, T. 5 N., R. 3 E.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) loam; weak, fine, granular structure; friable; roots abundant; slightly acid; lower boundary abrupt and smooth.

B1t—8 to 14 inches, dark reddish-brown (5YR 3/4) clay loam; thin, discontinuous, shiny clay films on ped surfaces; weak, fine and very fine, subangular blocky structure; firm when moist, sticky when wet; roots abundant; slightly acid; lower boundary clear and wavy.

B2t—14 to 19 inches, reddish-brown (5YR 4/4) clay loam; thicker clay films on ped surfaces than those in the B1t horizon; dark-brown (10YR 3/3) fillings along roots channels; weak, fine and very fine, subangular blocky structure; firm when moist, sticky when wet; more fine gravel than in the B1t horizon; roots abundant; medium acid; lower boundary clear and wavy.

B31t—19 to 23 inches, dark reddish-brown (5YR 3/4) clay; dark-brown (10YR 3/3) fillings along root channels; massive in place but moderate and weak, fine, subangular blocky structure along root channels; firm when moist, sticky when wet; 15 percent (by volume) of the soil mass consists of gravel, ¼ inch to 3 inches in diameter; roots plentiful; neutral; lower boundary abrupt and wavy.

IIB32—23 to 27 inches, dark reddish-brown (5YR 3/4) gravelly loam; small pockets of weak-red (2.5YR 4/2), weathered rock; massive; 30 percent (by volume) of soil mass consists of water-worked, weathered limestone fragments and of gravel, ¼ inch to 3 inches in diameter; roots plentiful; mildly alkaline; lower boundary gradual.

IIC1—27 to 36 inches, dark-brown (10YR 4/3), weathered, water-worked limestone fragments and disintegrated pebbles; a few pockets of gravelly sandy loam material; massive; strongly calcareous.

IIC2—36 to 60 inches, dark-brown (10YR 4/3), loose, fine to coarse gravel comprising 50 percent or more (by volume) of the soil mass; strongly calcareous.

The texture of the Ap or A1 horizon is loam, silt loam, or gravelly loam.

The clay content of the B1t horizon normally ranges from 21 to 35 percent. The color of the B2t horizon is generally dark reddish brown (5YR 3/4 to 3/2), dark brown (7.5YR 3/2 to 4/4), or reddish brown (5YR 4/4). The texture of these layers ranges from clay loam to clay. The soil is sticky when wet and

firm when moist. The B3 horizons contain sand, and up to 40 percent (by volume) of the soil mass is gravel.

Tongues of the B3 horizons extend as much as 14 inches into the C horizon, and, in places, clay flows extend further downward. The depth to sand and gravel is normally about 30 inches.

These soils are adjacent to the Ockley, Warsaw, and Wea soils. The Fox soils are not so deep to sand and gravel as the Ockley and well-drained Wea soils. Nevertheless, the Fox soils are moderately deep to sand and gravel, in contrast to the shallow Casco and very shallow Rodman soils. The Fox soils differ from the Warsaw soils in not having a dark-colored surface layer. The Fox soils are not underlain by till as are the Kendallville soils.

Fox gravelly loam, 0 to 2 percent slopes (FgA).—This soil has a profile similar to the one described as representative of the series, but 15 to 20 percent or more (by volume) of the soil material in the surface layer consists of gravel. The upper part of the subsoil contains more gravel than that of the representative profile. Also, this soil has less capacity to hold moisture.

The gravel in the surface layer hinders cultivation. The restricted capacity to hold moisture and the good natural drainage cause this soil to be droughty. The soil is well suited to irrigation, however. (Capability unit IIs-1)

Fox gravelly loam, 2 to 6 percent slopes (FgB).—This soil has a profile similar to the one described as representative of the series, but 15 to 20 percent or more (by volume) of the soil material consists of gravel. Also, the upper part of the subsoil contains more gravel.

The gravel in the surface layer hinders cultivation. This soil is suited to irrigation, but erosion is a hazard when it is cultivated. It is more droughty than the less gravelly Fox soils. (Capability unit IIe-2)

Fox gravelly loam, 2 to 6 percent slopes, moderately eroded (FgB2).—This soil has a profile similar to the one described as representative of the series, but 15 to 20 percent or more (by volume) of the soil material in the surface layer consists of gravel. Also, the upper part of the subsoil contains more gravel. The plow layer is a mixture of surface soil and material from the upper part of the subsoil.

The gravel in the surface layer hinders cultivation. Erosion is a hazard, and the soil tends to be droughty. Because of droughtiness and the high content of gravel, it is more difficult to establish seedlings on this soil than on the uneroded Fox soils. (Capability unit IIe-2)

Fox gravelly loam, 6 to 12 percent slopes, moderately eroded (FgC2).—This soil has a profile similar to the one described as representative of the series, but 15 to 20 percent (by volume) of the soil material in the surface layer consists of gravel. Also, the upper part of the subsoil contains more gravel. The plow layer is a mixture of material from the surface layer and the upper part of the subsoil.

The gravel in the surface layer hinders cultivation. Because of greater droughtiness and the high content of gravel, it is more difficult to obtain an adequate stand of seedlings on this soil than on the less gravelly Fox soils. This soil has a more severe hazard of erosion than the less sloping Fox soils. (Capability unit IIIe-2)

Fox loam, 0 to 2 percent slopes (FIA).—This soil occupies broad areas on outwash plains and stream terraces.

Included with this soil are some areas of the deeper Ockley soils that are too small to be shown separately on the soil map.

This Fox soil has slow surface runoff, medium available moisture capacity, and good natural drainage. Erosion is

not a hazard. During extended periods of dry weather, however, the soil is droughty. (Capability unit IIs-1)

Fox loam, 2 to 6 percent slopes (FIB).—This soil has medium to rapid surface runoff, and erosion is a hazard. The soil is suited to irrigation, however.

Included with this soil are some areas of deeper Ockley soils that are too small to be shown separately on the soil map. (Capability unit IIe-2)

Fox loam, 2 to 6 percent slopes, moderately eroded (FIB2).—The surface layer of this soil has been eroded, and the present plow layer is a mixture of the remaining surface soil and material from the upper part of the subsoil.

Included with this soil are some areas of deeper Ockley soils that are too small to be shown separately on the soil map.

This Fox soil has medium to rapid surface runoff, and erosion is a hazard. As a result of erosion, this soil is more droughty and has lower available moisture capacity than the uneroded Fox loams. (Capability unit IIe-2)

Fox loam, 6 to 12 percent slopes, moderately eroded (FIC2).—The surface layer of this soil has been eroded, and the present plow layer is a mixture of surface soil and material from the upper part of the subsoil. Most of this soil is between soils on first bottoms and less sloping, higher lying soils on stream terraces.

Included with this soil are some areas of deeper Ockley soils that are too small to be shown separately on the soil map.

This Fox soil has medium to rapid surface runoff, and erosion is a greater hazard than on less sloping Fox soils. As a result of erosion, it has less available moisture capacity than the uneroded Fox soils. (Capability unit IIIe-2)

Fox silt loam, 0 to 2 percent slopes (FmA).—This soil has a profile similar to the one described as representative of the series, but it contains less sand and is less gritty. Also, it has less gravel in the lower part of the subsoil. This soil occupies broad areas on outwash plains and stream terraces.

Included with this soil are some areas of deeper Ockley soils and moderately well drained Thackery soils. The Thackery soils occupy slight depressions.

This Fox soil has slow surface runoff, medium available moisture capacity, and good natural drainage. Erosion is not a hazard, but during extended dry periods, the soil is droughty. (Capability unit IIs-1)

Fox silt loam, 2 to 6 percent slopes (FmB).—This soil has a profile similar to the one described as representative of the series, but it contains less sand and is less gritty. Also, it has less gravel in the lower part of the subsoil.

Included with this soil are some areas of deeper Ockley soils that are too small to be shown separately on the soil map.

This Fox soil has medium to rapid surface runoff, and erosion is a hazard if it is cultivated. It is suited to irrigation. (Capability unit IIe-2)

Fox silt loam, 2 to 6 percent slopes, moderately eroded (FmB2).—This soil has a profile similar to the one described as representative of the series, but it contains less sand and is less gritty. Also, it has less gravel in the lower part of the subsoil. As a result of erosion, the plow layer is a mixture of the surface soil and material from the upper part of the subsoil.

Included with this soil are a few areas of the deeper Ockley soils that are too small to be shown separately on the soil map.

This Fox soil has medium to rapid surface runoff, and erosion is a hazard. Because of erosion, the soil has lower available moisture capacity than the uneroded Fox silt loams. (Capability unit IIe-2)

Fox silt loam, 6 to 12 percent slopes, moderately eroded (FmC2).—This soil has a profile similar to the one described as representative of the series, but it contains less sand and is less gritty. Also, it has less gravel in the lower part of the subsoil. As a result of erosion, the present plow layer is a mixture of the remaining surface soil and material from the upper part of the subsoil.

Included with this soil are a few areas of deeper Ockley soils that are too small to be shown separately on the soil map.

This Fox soil occupies areas between soils on first bottoms and less sloping, higher lying soils on stream terraces. Most areas are long and narrow, and the slopes are generally short. Consequently, the use of this soil is often the same as that of the surrounding soils. Surface runoff is medium to rapid, and erosion is a severe hazard if this soil is cultivated. (Capability unit IIIe-2)

Fox silt loam, 12 to 18 percent slopes, moderately eroded (FmD2).—This soil has a profile similar to the one described as representative of the series, but it contains less sand and is less gritty. Also, it has less gravel in the lower part of the subsoil. As a result of erosion, the present plow layer is a mixture of the remaining surface soil and material from the upper part of the subsoil.

This soil is between soils on first bottoms and higher lying, less sloping soils on stream terraces. Most areas are long and narrow, and slopes are short. Surface runoff is rapid, and the hazard of erosion is very severe if this soil is cultivated. (Capability unit IVe-1)

Fox soils, 6 to 12 percent slopes, severely eroded (FsC3).—These soils have a profile similar to the one described as representative of the series, but the original surface layer has been removed by erosion. The clay loam plow layer has poor tilth and a very low content of organic matter. In places there is enough gravel in the plow layer to hinder tillage. The root zone is moderately deep to shallow, the available moisture capacity is low, and surface runoff is rapid.

These soils are between soils on first bottoms and less sloping soils on stream terraces. They occur in long, narrow, irregular areas, and the slopes are short. Consequently, these soils are often used in the same way as the surrounding soils. If cultivated, they have a very severe hazard of erosion. (Capability unit IVe-2)

Fox soils, 12 to 18 percent slopes, severely eroded (FsD3).—These soils have a profile similar to the one described for the series, but the original surface layer has been removed by erosion. The clay loam plow layer has poor tilth and a very low content of organic matter. The root zone is shallow because of loss of soil through erosion and shallowness to sand and gravel. The available moisture capacity is low. Surface runoff is rapid.

These soils occupy irregularly shaped areas and have been farmed along with less sloping surrounding soils. Because of the degree of slope and a very severe hazard of erosion, these Fox soils should not be cultivated. (Capability unit VIe-1)

Gravel Pits

Gravel pits (Gp) is a miscellaneous land type. The upper layers of soil have been removed or pushed aside so that the sandy and gravelly substratum can be removed for use in construction and roadbuilding.

The large pits are outlined on the soil map. Most of them are used for commercial purposes. Small pits are indicated by the special symbol for gravel pits.

This land type has no potential for agricultural use. (Capability unit VIIIs-1)

Gullied Land

In Preble County there are three mapping units of this miscellaneous land type.

Gullied land, rolling (GuC).—This land type is on hillsides and high knolls and at the heads of drainageways. It occupies a limited acreage in the county. Slopes range from 6 to 12 percent.

Areas of this land type have an intricate pattern of moderately deep or deep, raw gullies. They consist mostly of Miami soils that have been so misused that all the surface soil and nearly all of the subsoil have been removed, except in small spots between gullies. Most of the erosion has been caused by water running across the areas from surrounding areas.

The surface layer is neutral to calcareous in reaction, and tilth is generally poor. Erosion is a very severe hazard, unless permanent vegetation is established. (Capability unit VIIe-1)

Gullied land, hilly (GuD).—This miscellaneous land type is on hillsides and along streambanks. It occupies a limited acreage in the county. Slopes range from 12 to 18 percent.

Areas of this land type have an intricate pattern of moderately deep or deep, raw gullies. They consist of Miami and Russell soils that have been eroded so much that all the surface soil and nearly all the subsoil have been removed, except in small spots between gullies. Most of the erosion has been caused by water running across the areas from surrounding areas.

The surface layer is neutral to calcareous in reaction, and tilth is poor. Erosion is a very severe hazard, unless permanent vegetation is established. (Capability unit VIIe-1)

Gullied land, steep (GuF).—The areas of this miscellaneous land type have been dissected by streams. Only a limited acreage occurs in the county. Slopes range from 18 to 50 percent.

Areas of this land type have an intricate pattern of moderately deep or deep, raw gullies. They consist mostly of Miami, Fox, and Hennepin soils that have been so misused that all the surface soil and nearly all the subsoil has been removed, except in small spots between gullies. Most of the erosion has been caused by water running across the areas from surrounding areas.

The surface layer is neutral to calcareous in reaction. Seedings will respond to fertilizer, however. For the prevention of further gullying, growth of all types of permanent vegetation is needed. (Capability unit VIIe-1)

Hennepin Series

In the Hennepin series are steep to very steep, well-drained soils that are shallow to calcareous glacial till. These soils are in uplands in every township in the county. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Hennepin soil has a very dark brown silt loam surface layer about 4 inches thick. This is underlain by a thin, dark yellowish-brown subsoil of clay loam. At a depth of about 11 inches is yellowish-brown, calcareous loam till.

The Hennepin soils have a low to medium content of organic matter, moderately slow permeability, and very low available moisture capacity.

Most areas of Hennepin soils are too shallow and too steep to be suited to cultivation. They are used for pasture and woodland.

Technical description of a profile of Hennepin silt loam on a wooded slope in Israel Township, NW $\frac{1}{4}$ sec. 8, T. 6 N., R. 1 E.:

- A—0 to 4 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable; pH 6.6; lower boundary clear and smooth.
- B—4 to 11 inches, dark yellowish-brown (10YR 3/4) coarse clay loam; moderate, fine, subangular blocky structure; firm; pH 6.8; lower boundary gradual and wavy.
- C—11 to 60 inches, yellowish-brown (10YR 5/4) calcareous loam till; a few tongues of dark yellowish brown (10YR 3/4) extend into this horizon from the B horizon.

The color of the A horizon ranges from very dark brown (10YR 2/2) in undisturbed areas to yellowish brown (10YR 5/4) in eroded areas. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline. Depth to the calcareous C horizon ranges from 8 to about 15 inches.

The Hennepin soils are adjacent to steep Miami and Fox soils but are shallower to calcareous till than these soils.

In Preble County the Hennepin soils are mapped only in undifferentiated soil groups with the Miami and Fox soils. See the descriptions of the Miami, Fox, and Hennepin soils under the Miami series.

Kendallville Series

The Kendallville series consists of nearly level to very steep, well-drained soils formed in thin deposits of glacial outwash over calcareous loam till. These soils are deep to bedrock, but in some places they are only moderately deep to calcareous till material. They occur in uplands and are in every township in the county. The native vegetation was a mixed stand of deciduous hardwoods.

A typical cultivated Kendallville soil has a brown silt loam plow layer that is friable. It has an upper subsoil of brown clay loam that is also friable. The lower part of the subsoil, from a depth of 20 to 38 inches, is dark-brown or dark reddish-brown sandy clay loam or gravelly sandy clay loam. Calcareous loam till is below a depth of 38 inches.

Permeability of the Kendallville soils is moderate in the solum but moderately slow in the underlying till. The available moisture capacity is high, and the organic-matter content is medium.

The Kendallville soils are suited to a variety of agricultural uses, depending on degree of slope and amount of erosion.

Technical description of a profile of Kendallville silt loam in a nearly level cultivated field in the SW $\frac{1}{4}$ sec. 26, T. 5 N., R. 3 E.:

- Ap—0 to 6 inches, brown (10YR 4/3) silt loam; pale brown (10YR 6/3) when dry; weak, medium, platy structure in upper 2 inches and weak, coarse, subangular blocky below; friable; abundant roots; medium acid; lower boundary abrupt and smooth.
- A2—6 to 9 inches, brown (7.5YR 4/4) silt loam; silty coatings of yellowish brown (10YR 5/4); weak, fine and medium, subangular blocky structure; friable; plentiful roots; slightly acid; lower boundary clear and smooth.
- B1—9 to 12 inches, brown (7.5YR 4/4) coarse clay loam; moderate, fine and medium, subangular blocky structure; friable; plentiful roots; slightly acid; lower boundary clear and smooth.
- B21t—12 to 20 inches, brown (7.5YR 4/4) clay loam; discontinuous, shiny clay coatings on some ped surfaces; moderate, medium, subangular and angular blocky structure; friable; few roots; few igneous pebbles up to one-half inch in diameter; slightly acid; lower boundary clear and smooth.
- B22t—20 to 27 inches, dark-brown (7.5YR 3/2) to dark reddish-brown (5YR 3/4) gravelly sandy clay loam; discontinuous, shiny clay coatings on some ped surfaces; weak, medium, subangular blocky structure; friable; few roots; few igneous pebbles about $\frac{1}{2}$ to 1 inch in diameter; slightly acid; lower boundary clear and smooth.
- B23—27 to 31 inches, dark-brown (7.5YR 3/2) to brown (7.5YR 4/4) sandy clay loam; weak, fine, crumb structure; friable; few small igneous pebbles about $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter; slightly acid; lower boundary clear and smooth.
- B3—31 to 38 inches, dark reddish-brown (5YR 3/4) to dark-brown (7.5YR 3/2) gravelly sandy clay loam; weak, fine, crumb structure; friable; few igneous pebbles about $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter; neutral; lower boundary abrupt and smooth.
- IIC1—38 to 44 inches, dark yellowish-brown (10YR 4/4), calcareous loam till; few, discontinuous dark-brown (10YR 4/3) clay flows and light-gray (10YR 7/2) streaks of silt; massive; friable.
- IIC2—44 to 49 inches, yellowish-brown (10YR 5/4), calcareous loam till; few light-gray (10YR 7/2) streaks of silt; massive.
- IIC3—49 to 55 inches, yellowish-brown (10YR 5/4), calcareous loam till; few light-gray (10YR 7/2) streaks of silt; massive.

The Kendallville soils have a silty mantle that ranges from very shallow to as much as 24 inches thick. In places there is no mantle. The silty mantle is thickest where the Kendallville soils are adjacent to the Russell soils. The total thickness of the silty mantle and glacial outwash material is as much as 40 inches over the till. The solum ranges in thickness from about 30 to 40 inches.

The reaction of the surface layer ranges from medium acid to neutral. The texture of the lower B horizon is sandy clay loam, sandy clay, or gravelly clay loam. The color of the B2 horizon ranges from reddish brown (5YR 4/3) to dark yellowish brown (10YR 3/4).

The Kendallville soils are next to the Russell, Miami, Xenia, Celina, and Ockley soils. They have a thinner silty mantle than the Russell soils. Unlike the Miami soils, their subsoil has formed in outwash material. They are better drained than the Celina and Xenia soils, and they differ from Ockley soils in being underlain by calcareous till.

In Preble County the Kendallville soils are mapped only in undifferentiated soil groups with the Ockley soils. For descriptions of these mappings units, see the Ockley series.

Landes Series

The Landes series consists of deep, dark-colored, well-drained, nearly level soils that have formed in sandy sediments on flood plains. The areas are scattered along most

of the streams in the county. The native vegetation was a mixed stand of deciduous hardwoods.

The typical Landes soil has a very dark grayish-brown to dark-brown sandy loam surface layer that has granular structure and is neutral or calcareous in reaction. The deeper layers are made up of sandy loam or loam but contain some fine gravel. They are friable and calcareous. The underlying material, at a depth of about 41 inches, is loamy sand.

The Landes soils have moderate to moderately rapid permeability. The root zone is moderately deep to deep. The available moisture capacity is low to medium, and crops are likely to be damaged by lack of moisture in dry years.

Most of the acreage of the Landes soils is cultivated. Flooding is a hazard, however.

Technical description of a profile of a typical Landes sandy loam in a cultivated field in Gasper Township, SE $\frac{1}{4}$ sec. 14, T. 7 N., R. 2 E.:

- A11—0 to 6 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; very friable; abundant roots; neutral; abrupt, smooth lower boundary.
- A12—6 to 10 inches, dark-brown (10YR 3/3) sandy loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth lower boundary.
- C1—10 to 19 inches, dark-brown (10YR 3/3) sandy loam; massive in place; friable; calcareous; clear, wavy lower boundary.
- C2—19 to 32 inches, dark-brown (10YR 4/3) sandy loam; massive; very friable; 5 to 10 percent of soil mass is fine gravel; calcareous; diffuse, wavy lower boundary.
- C3—32 to 41 inches, dark yellowish-brown (10YR 3/4) loam; massive; friable; calcareous; abrupt, wavy lower boundary.
- C4—41 to 50 inches, dark yellowish-brown (10YR 3/4) loamy sand; massive; friable; calcareous; diffuse, wavy lower boundary.
- C5—50 to 59 inches; brown (10YR 4/3) gravelly loamy sand; massive; friable; calcareous.

The texture of the A horizon is sandy loam or gravelly sandy loam. At depths between 10 and about 40 inches, the texture is sandy loam, loam, and silt loam. The clay content in this zone is generally 12 to 15 percent.

The color of the surface horizon is very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), and dark brown (10YR 3/3). The deeper layers are dark yellowish brown (10YR 4/4 and 10YR 3/4), brown (10YR 4/3), and dark grayish brown (10YR 4/2). In some places the Landes soils have faint grayish mottles below a depth of 30 inches.

The Landes soils are neutral to slightly calcareous in the upper 18 inches and generally calcareous below a depth of 18 inches.

Depth to calcareous sand or sand and gravel ranges from about 28 to 60 inches.

The Landes soils are generally adjacent to well-drained Ross soils. They are sandier than the Ross and Medway soils. They are better drained than the Medway soils, which are mottled at depths beginning at 18 to 24 inches.

Landes gravelly sandy loam (lg).—This soil has a profile similar to the one described as representative of the series, but the surface layer and underlying layers contain at least 15 to 20 percent more gravel.

This soil is on first bottoms. It occurs in small areas and as strips along the large streams. This soil also occurs along and in the high water channels of these streams. It is subject to overflow during periods of high water, normally once a year in winter or spring.

Included with this soil are a few areas that have bed-rock or flagstone, or both, at a depth of 35 to 48 inches. Most of these areas are south of Eaton, along Seven Mile Creek and its tributaries.

Because of the hazard of flooding, this soil is generally unsuitable for winter-grown small grains or hay unless it is protected by levees. Since it contains more gravel, it is more droughty than Landes sandy loam. In a few areas the large amount of gravel in the surface layer hinders tillage. (Capability unit IIw-3)

Landes sandy loam (ld).—This soil occupies small areas on the first bottoms of the large streams and is subject to overflow during periods of high water, normally about once a year in winter or spring.

Included with this soil are a few areas in which gravel makes up 15 percent or more of the surface layer.

Because it is droughty, this Landes soil is best suited to crops that mature early in summer. Since flooding is a hazard, the soil is generally unsuitable for winter-grown small grains or hay unless it is protected by levees. (Capability unit IIw-3)

Landes Series, Gravelly Subsoil Variant

This variant of the Landes series is similar to soils of the Landes series, but it is shallower to gravelly material. Depth to gravel ranges from 13 to 28 inches. The root zone is shallow, and the available moisture capacity is very low. Drought is a hazard.

Technical description of a profile of Landes sandy loam, gravelly subsoil variant, in a cultivated field in Somers Township, sec. 3, T. 6 N., R. 2 E.:

- Ap1—0 to 6 inches, very dark brown (10YR 2/2) sandy loam; dark brown (10YR 3/3) when crushed; weak, fine, granular structure; friable; few igneous pebbles up to one-half inch in diameter; abundant roots; mildly alkaline; lower boundary gradual and smooth.
- Ap2—6 to 11 inches, very dark brown (10YR 2/2) sandy loam; dark brown (10YR 3/3) when crushed; weak, fine and medium, granular structure; friable; few igneous pebbles about $\frac{1}{2}$ to 1 inch in diameter; abundant roots; neutral; lower boundary gradual and smooth.
- C1—11 to 15 inches, very dark brown (10YR 2/2) sandy loam; dark brown (10YR 3/3) when crushed; massive; friable; few igneous pebbles about $\frac{1}{2}$ to 1 inch in diameter; plentiful roots; neutral; lower boundary abrupt and smooth.
- C2—15 to 18 inches, very dark brown (10YR 2/2) sandy clay loam; dark brown (10YR 3/3) when crushed; massive; friable; many igneous and limestone pebbles about $\frac{1}{2}$ to 1 inch in diameter; plentiful roots; neutral; lower boundary abrupt and smooth.
- III3C—18 to 23 inches, dark-brown (10YR 3/3) gravelly loam; structureless; many igneous and limestone pebbles $\frac{1}{2}$ inch to 6 inches in diameter; few roots; calcareous; lower boundary gradual and wavy.
- IVC4—23 inches +, calcareous gravel.

In some areas the surface layer and underlying layers are gravelly.

Landes sandy loam, gravelly subsoil variant (lg).—This soil lies on first bottoms along narrow high-water channels and sloughs. It is subject to flooding by swift-moving water during winter or spring.

In some places the large amount of gravel in the surface layer hinders cultivation. Unless protected from flooding, this soil is not suited to winter-grown small grains. Other limitations are shallowness to gravel and low available moisture capacity. (Capability unit IIIs-1)

Lewisburg Series

In the Lewisburg series are moderately well drained and well drained, gently sloping to sloping soils formed from calcareous loam till of the Wisconsin age. These soils of the uplands are shallow to till. The largest area is southwest of Eldorado and extends north from Gettysburg to the Darke County line. Another area is along the Preble and Montgomery County line southeast of Lewisburg. The native vegetation was a mixed stand of maple, beech, oak, and other deciduous hardwoods.

The plow layer of a typical Lewisburg soil is made up of dark-brown friable silt loam. The subsoil, to a depth of about 13 inches, is friable to firm, dark-brown to brown clay loam. The underlying substratum is brownish, firm, loam till.

The organic-matter content of the plow layer is medium in areas that are not severely eroded. The permeability of the subsoil and substratum is moderately slow. The root zone is shallow because the underlying till is compacted. The available moisture capacity is low.

Most areas of the Lewisburg soils are farmed. Corn, soybeans, wheat, and other crops common to the area are grown. Crops respond well to fertilizer. The major hazard is erosion. In addition, downward movement of water through the subsoil and substratum is restricted. Therefore, during wet weather these soils are saturated and are ponded where they occur in depressions.

Technical description of a profile of Lewisburg silt loam, 2 to 6 percent slopes, in a meadow in Twin Township, sec. 1, T. 6 N., R. 3 E.:

- Ap—0 to 6 inches, dark-brown (10YR 3/3) silt loam; massive in place but breaks to weak, medium, subangular blocky structure; friable; medium acid; lower boundary clear and smooth.
- B1—6 to 7 inches, dark-brown (10YR 3/3) loam; weak, medium, subangular blocky structure; friable, neutral; lower boundary abrupt and smooth.
- B2t—7 to 9 inches, dark-brown (10YR 3/3) clay loam; moderate, fine and medium, subangular blocky structure; medium, continuous clay films on ped surfaces; friable; neutral; lower boundary abrupt and smooth.
- B3t—9 to 13 inches, brown (10YR 4/3) clay loam; moderate, fine and medium, subangular blocky structure; medium, discontinuous clay films on ped surfaces; firm; many limestone pebbles and fragments; slightly calcareous; lower boundary gradual and wavy.
- C1—13 to 16 inches, dark yellowish-brown (10YR 4/4) clay loam; dark-brown (10YR 3/3) clay films on ped surfaces; weak, medium, subangular blocky structure; firm; strongly calcareous; lower boundary diffuse.
- C2—16 to 22 inches, loam that is light olive brown (2.5Y 5/4) when crushed; medium, discontinuous, brown (10YR 4/3) clay films on ped surfaces; weak, medium, subangular blocky structure; extremely firm; strongly calcareous; lower boundary diffuse.
- C3—22 to 28 inches, loam till that is yellowish brown (10YR 5/4) when crushed; massive; extremely firm in place; strongly calcareous; lower boundary diffuse.
- C4—28 to 60 inches, loam till that is yellowish brown (10YR 5/4) when crushed; light brownish-gray (10YR 6/2) seams $\frac{1}{4}$ to $\frac{1}{2}$ inch wide; massive; firm; strongly calcareous.

The depth to calcareous till is fairly variable over short distances and ranges from 8 to 18 inches.

In some uncultivated areas, these soils have a thin A2 horizon. The Ap horizon ranges from brown (10YR 4/3) to dark brown (10YR 3/3) and from medium acid to neutral. The pH increases with depth.

In places faint mottling occurs in the B3t and C1 horizons.

These soils are adjacent to the somewhat poorly drained Pymont soils. Other nearby soils are the well drained Miami,

moderately well drained Celina, somewhat poorly drained Crosby, and very poorly drained Brookston. The Lewisburg soils differ from the Miami and Celina soils in that they are shallower (less than 18 inches) to the underlying till and, therefore, have a thinner surface soil and subsoil.

Lewisburg silt loam, 2 to 6 percent slopes (LsB).—This soil occupies low, elongated knolls and large areas between intermittent streams.

Included with this soil are a few areas of Pymont soils that are too small to be shown separately on the soil map.

When this Lewisburg soil is cultivated, erosion is a hazard. (Capability unit IIe-1)

Lewisburg silt loam, 2 to 6 percent slopes, moderately eroded (LsB2).—This soil has a profile similar to the one described as representative of the series, except that the surface layer has been eroded. The present surface layer is a mixture of the remaining surface soil and material from the upper part of the subsoil. This soil occupies knolls and large areas between intermittent streams. Surface runoff is medium, and erosion is a continuing hazard. (Capability unit IIe-1)

Lewisburg soils, 6 to 12 percent slopes, severely eroded (LsC3).—These soils have a profile similar to the one described as representative of the series, except that erosion has removed the original surface soil. The present plow layer, a mixture of subsoil material, has a very low content of organic matter and poor tilth. These soils occupy knolls and areas along intermittent streams.

Some moderately eroded areas have been included with this mapping unit.

These Lewisburg soils have a very shallow root zone and very low available moisture capacity. Surface runoff is rapid, and, when cultivated, the soils have a very severe hazard of erosion. (Capability unit IVe-2)

Made Land and Borrow Pits

Made land and Borrow pits (Mb) is nearly level to very steep. It consists of areas of soil or refuse fill, quarry spoil, and open dumps, and also of areas that have been leveled for construction sites or stripped of their upper layers to provide fill material. In general, these areas have little or no agricultural value. (Capability unit VIIIIs-1)

Medway Series

The Medway series consists of deep, moderately well drained soils that are dark colored. These nearly level soils are on bottom lands. They have formed in recently deposited, medium-textured sediments. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Medway soil has a very dark grayish-brown, friable loam or silt loam surface layer about 13 inches thick. The subsoil is dark-brown, friable loam and sandy clay loam to a depth of about 27 inches. Below this is dark yellowish-brown and dark-brown friable sandy loam that continues to a depth of about 40 inches. This is underlain by calcareous loamy sand and gravelly loam.

The Medway soils have moderate to high available moisture capacity, high organic-matter content, moderate permeability, and a deep root zone.

Flooding is a hazard on the Medway soils, but generally summer crops can be planted and harvested without damage. The water table is high in winter and spring.

Technical description of a profile of a nearly level Medway silt loam in a pasture in Washington Township, SE $\frac{1}{4}$ sec. 21, T. 8 N., R. 2 E.:

- A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine and medium, granular structure; friable; abundant roots; medium acid; lower boundary diffuse.
- A12—5 to 9 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine and medium, granular structure; friable; plentiful roots; medium acid; lower boundary diffuse.
- A13—9 to 13 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, subangular blocky structure; friable; plentiful roots; medium acid; lower boundary abrupt and smooth.
- B1—13 to 17 inches, dark-brown (10YR 4/3) loam with very dark grayish-brown (10YR 3/2) mottles; moderate, medium, subangular blocky structure; friable; few roots; slightly acid; lower boundary diffuse.
- B2—17 to 22 inches, dark-brown (10YR 4/3) loam; few, medium, distinct dark-brown (7.5 YR 4/4) mottles; moderate, medium, subangular blocky structure; friable; some roots; slightly acid; lower boundary clear and smooth.
- B3—22 to 27 inches, dark-brown (10YR 4/3) sandy clay loam; thin, discontinuous, dark yellowish-brown (10YR 3/4) ped coatings and few, fine, faint, brown (7.5YR 4/4) mottles; weak, medium, subangular blocky structure; friable; neutral; lower boundary clear and wavy.
- C1—27 to 32 inches, dark yellowish-brown (10YR 4/4) sandy loam; dark yellowish-brown (10YR 3/4) streaks and dark-brown (10YR 3/3) worm casts; massive; friable; neutral; lower boundary clear and wavy.
- C2—32 to 38 inches, dark-brown (10YR 4/3) sandy loam; dark-brown (10YR 3/3) pockets and few, fine, distinct, strong-brown (7.5YR 5/6) mottles; massive; few igneous and limestone pebbles; slightly calcareous; lower boundary abrupt and smooth.
- C3—38 to 40 inches, mixed gray (10YR 5/1) and yellowish-brown (10YR 5/4) sandy loam; massive; slightly calcareous; this sand lens was 1 to 3 inches thick in the pit; lower boundary abrupt and smooth.
- C4—40 to 48 inches, gravelly loam that is a mixture of dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/6), light yellowish brown (10YR 6/4), brownish yellow (10YR 6/8), and light brownish gray (10YR 6/2); massive; common igneous pebbles and many weathered limestone pebbles; slightly calcareous.
- C5—48 to 54 inches, grayish-brown (10YR 5/2) dirty sand and gravel; single grain; slightly calcareous.

The color of the A horizon ranges from very dark grayish brown (10YR 3/2) to black (10YR 2/1); very dark grayish brown is most common. The texture of this horizon is silt loam or loam (silt loam is the only soil type mapped in this county). Thickness of the A horizon ranges from 11 to 18 inches.

In the B horizon the grade of structure is weak or moderate. In the C horizon the material above the coarse underlying material is in either a single thick layer or in stratified layers of various texture, such as loam, silt loam, coarse clay loam, sandy clay loam, and sandy loam.

The Medway soils are adjacent to the well-drained Ross soils, somewhat poorly drained Shoals soils, and very poorly drained Sloan soils.

Medway silt loam (Md).—This soil is subject to overflow during periods of high water that generally occur at least once a year. It is well suited to row crops, however, because they can normally be planted and harvested during the nonflooding period. Tilt is good over a wide range of moisture conditions. Erosion is not a problem.

Included with this soil are a few spots in which the surface layer is loam or sandy loam and some areas of Sloan soils that are too small to be shown separately on the soil map. The Sloan soils have gray and yellow mottling within 12 inches of the surface. This indicates that wetness is a problem. In some areas limestone bedrock is at depths

of 35 to 48 inches. In a few areas the surface layer is dark yellowish brown. (Capability unit IIw-3)

Miami Series

Soils in the Miami series are deep, well drained, and nearly level to very steep. They have formed from calcareous loam till or from silt-mantled till. They occupy uplands (fig. 6) and occur in every township in the county. The native vegetation was a mixed stand of deciduous hardwoods.

A typical profile of a cultivated Miami soil (fig. 7) has a dark-brown, friable silt loam plow layer about 7 inches thick. It has a yellowish-brown, clayey subsoil that has strong structure. Yellowish-brown, calcareous loam till is at a depth of about 26 inches. This till is compact and limits the root zone.

Where uneroded, the Miami soils have a medium content of organic matter. They have moderately slow permeability, and, above the calcareous till, they are mostly strongly acid to medium acid.

The Miami soils are used fairly intensively for agriculture.

Technical description of a profile of a gently sloping Miami silt loam in a cultivated field in Gratis Township, NW $\frac{1}{4}$ sec. 19, T. 4 N., R. 3 E. (Sample PB-4 in laboratory analyses):

- Ap1—0 to 4 inches, dark brown (10YR 4/3) silt loam; weak, fine, crumb structure; friable; medium acid.
- Ap2—4 to 7 inches, dark brown (10YR 4/3) silt loam; brown (10YR 5/3) when crushed; weak, fine, crumb structure; friable; medium acid; lower boundary abrupt and smooth.
- B1—7 to 10 inches, yellowish-brown (10YR 5/4) clay loam; dark yellowish-brown (10YR 4/4) coatings on ped surfaces; moderate, fine and medium, subangular blocky structure; firm; very strongly acid; lower boundary clear and wavy.
- B21t—10 to 14 inches, dark yellowish-brown (10YR 4/4) fine clay loam; strong, medium, subangular blocky structure; firm; very strongly acid; lower boundary clear and irregular.
- B22t—14 to 18 inches, dark yellowish-brown (10YR 4/4) fine clay loam; dark-brown (10YR 3/3) coatings on the ped surfaces; strong, medium and coarse, angular blocky structure; very firm; very strongly acid; lower boundary clear and irregular.



Figure 6.—A field consisting of Miami and Kendallville soils on the crest of the Camden moraine. Miami soils are in the foreground, and Kendallville soils are in the background.

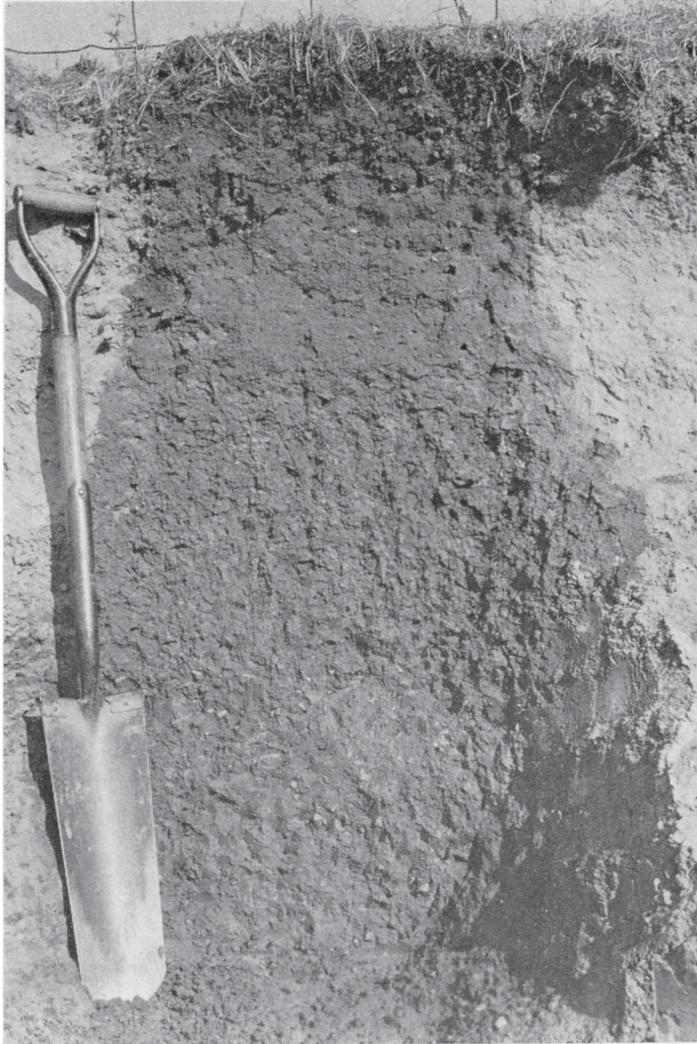


Figure 7.—Profile of a Miami silt loam that was formerly cultivated but is now covered by a thick sod of bluegrass.

- B23t—18 to 22 inches, yellowish-brown (10YR 5/4) clay loam; dark yellowish-brown (10YR 3/4) coatings on ped surfaces; strong, coarse, angular blocky structure; very firm; medium acid; lower boundary clear and irregular.
- B3t—22 to 26 inches, yellowish-brown (10YR 5/4) clay loam; many thin clay coatings of dark yellowish brown (10YR 3/4 and 10YR 4/4); moderate, coarse, angular blocky structure; firm; many limestone fragments; calcareous; lower boundary abrupt and wavy.
- C1—26 to 35 inches, yellowish-brown (10YR 5/4) loam; light-gray (10YR 7/2) lime seams; massive; friable; calcareous.
- C3—35 to 60 inches, yellowish-brown (10YR 5/4) loam; massive; friable; calcareous.

The silty upper mantle of the Miami soils ranges from very thin to as much as 18 inches thick. In places there is no mantle. The color of the Ap horizon is dark brown (10YR 4/3 or 10YR 3/3) or dark grayish brown (10YR 4/2). The B22t horizon consists of clay loam or clay that ranges from dark reddish brown (5YR 3/3) to dark brown (10YR 4/3) or dark yellowish brown (10YR 4/4).

Miami soils commonly have clay texture in places where the depth to calcareous till is near the minimum end of the range (18 inches). The texture is more likely to be clay loam in

areas that are near the maximum thickness to the till (36 inches).

In many places the Miami soils are adjacent to the moderately well drained Celina soils, somewhat poorly drained Crosby soils, and very poorly drained Brookston soils. In places they are next to the Russell soils. They have a thinner capping of silt (less than 18 inches) than the Russell soils.

Miami bouldery silt loam, 6 to 12 percent slopes, moderately eroded (MeC2).—This soil only occurs in the boulder belt shown on the general soil map. It is on hillsides, on high knolls of moraines, and along the banks of intermittent streams.

It has thin layers above the calcareous till and is near the minimum end of the range in thickness to till. As a result of erosion, about 50 percent of the plow layer consists of material from the subsoil. Many boulders are on the surface and throughout the profile.

The available moisture capacity is low to moderate, and the root zone is thin because of shallowness to compact till. Modern farming equipment cannot be used unless the boulders are removed. There is a severe hazard of erosion, however, if the boulders are removed and the soil is cultivated. (Capability unit IIIe-1)

Miami silt loam, 6 to 12 percent slopes (MiC).—This soil occurs on hillsides and along the banks of intermittent streams.

The soil has a medium content of organic matter. The available moisture capacity is moderate, and the root zone is moderately deep. This soil has good tilth, and crops respond well to lime and fertilizer. But when the soil is cultivated, surface runoff is rapid and the hazard of erosion is severe. (Capability unit IIIe-1)

Miami silt loam, 6 to 12 percent slopes, moderately eroded (MiC2).—This soil occurs on hillsides, on high knolls of moraines, and along the banks of intermittent streams. It has a profile that is shallower to calcareous loam till than the profile described as representative of the series. Part of the original plow layer has been removed by erosion. The present plow layer is a mixture of the original plow layer and subsoil.

This soil has fair tilth, but the organic-matter content is low. The available moisture capacity is moderate, and the root zone is shallow to moderately deep because of varying depths to compact till. Surface runoff is rapid, and susceptibility to erosion is moderate to high if this soil is cultivated. Crops respond well to lime and fertilizer, however. (Capability unit IIIe-1)

Miami silt loam, 12 to 18 percent slopes (MiD).—This soil occurs on hillsides and along drainageways. It has a profile that is shallower to calcareous loam till than the profile described as representative of the series.

The soil has a medium content of organic matter. The available moisture capacity is moderate, and in most places the root zone is moderately deep. Surface runoff is very rapid. When cultivated, this soil is highly susceptible to erosion. Tilth is good, however, and crops respond well to lime and fertilizer. (Capability unit IVe-1)

Miami silt loam, 12 to 18 percent slopes, moderately eroded (MiD2). This soil is on hillsides and along drainageways. It has a profile that is shallower to calcareous loam till than the profile described as representative of the series. Part of the original plow layer has been removed by erosion. The present plow layer is a mixture of the original plow layer and subsoil.

This soil has only fair tilth. The organic-matter content is low. The available moisture capacity is low to moderate, and the root zone is shallow because of limited depth of compact till. Surface runoff is very rapid, and, if cultivated, the soil is highly susceptible to further erosion. Crops respond well to lime and fertilizer, however. (Capability unit IVe-1)

Miami soils, 6 to 12 percent slopes, severely eroded (MmC3).—These soils occur on hillsides, on moraine knolls, and along drainageways. The profile differs from that described as representative of the series in that it is shallower to calcareous loam till and has a slightly acid to neutral surface layer. Most of the original surface layer has been removed by erosion, and the present plow layer consists almost entirely of subsoil and is more clayey than that of uneroded Miami silt loams.

These soils have poor tilth and a low content of organic matter. The available moisture capacity is low, and the root zone is thin because of shallowness to compact till. Surface runoff is rapid, and, if cultivated, the soil is highly susceptible to further erosion. Crops respond well to fertilizer, however. (Capability unit IVe-2)

Miami soils, 12 to 18 percent slopes, severely eroded (MmD3).—These soils occur on hillsides and along drainageways. The profile differs from that described as representative of the series in that it is shallower to calcareous loam till and has a neutral surface layer. Most of the original surface layer has been removed by erosion, and the present surface layer consists almost entirely of subsoil and is clayey.

These soils have poor tilth and a low content of organic matter. The available moisture capacity is low, and the root zone is thin because of shallowness to compact till.

As a result of severe erosion, these soils are poorly suited to cultivated crops. Erosion is a severe hazard in pastured areas if adequate cover is not maintained. Pasture plants respond well to fertilizer, however. (Capability unit VIe-1)

Miami-Celina bouldery silt loams, 2 to 6 percent slopes (MnB).—The soils of this complex are on low knolls, on ridgetops, and along drainageways. They occur in the boulder belt shown on the general soil map. This complex consists of about 60 percent Miami soils and 40 percent Celina soils.

These soils have moderate available moisture capacity, a medium content of organic matter, and a moderately deep root zone. Surface runoff is medium.

Unless the many boulders on and in the plow layer are removed, farm machinery cannot be used efficiently. If boulders are removed, these soils can be cultivated. The soils are subject to a moderate hazard of erosion when cultivated. (Capability unit IIe-1)

Miami-Celina bouldery silt loams, 2 to 6 percent slopes, moderately eroded (MnB2).—The soils of this complex are on low knolls, on ridgetops, and along drainageways. They occur in the boulder belt shown on the general soil map. This complex has about 60 percent Miami soils and 40 percent Celina soils. The soils are like Miami-Celina bouldery silt loams, 2 to 6 percent slopes, except that part of the original surface layer has been removed by erosion.

The available moisture capacity is moderate, but the organic-matter content is low. The root zone is moderately deep to shallow. Surface runoff is medium.

Unless the many boulders on and in the plow layer are removed, farm machinery cannot be used efficiently. If the boulders are removed, these soils can be cultivated. If cultivated, however, they have a moderate hazard of erosion. (Capability unit IIe-1)

Miami-Celina silt loams, 2 to 6 percent slopes (MoB).—The soils of this complex are on low knolls, on ridgetops, and along drainageways. Miami soils are on the higher knolls and steeper areas.

The available moisture capacity is medium, and the root zone is moderately deep. Both soils have a medium content of organic matter. Surface runoff is medium, and, if cultivated, the soils are susceptible to erosion. Tilth is good, however, and crops respond well to lime and fertilizer. (Capability unit IIe-1)

Miami-Celina silt loams, 2 to 6 percent slopes, moderately eroded (MoB2).—These soils are on low knolls, on ridgetops, and along drainageways. Miami soils are on the higher knolls and steeper areas. Part of the original plow layer of both soils has been removed by erosion. The present plow layer is a mixture of the original plow layer and material from the subsoil.

The soils have fair tilth, but the organic-matter content is low. The available moisture capacity is moderate, and the root zone is moderately deep to shallow. Surface runoff is medium, and, if cultivated, the soils are moderately susceptible to further erosion. Crops respond well to lime and fertilizer, however. (Capability unit IIe-1)

Miami-Celina soils, 2 to 6 percent slopes, severely eroded (MpB3).—The soils of this complex are on low knolls, on ridgetops, and along drainageways. Their profiles differ from the representative profiles described for the Miami and Celina series in that they are shallower to calcareous loam till and have a slightly acid to neutral surface layer. In most places the soils have slopes of 4 to 5 percent. Most of the original surface layer has been removed by erosion. The present plow layer consists almost entirely of clayey subsoil material.

The soils have poor tilth and a low organic-matter content. The available moisture capacity is low, and the root zone is shallow because of limited depth to compact till. Surface runoff is medium, and, if cultivated, the soils are moderately to highly susceptible to further erosion. Crops respond well to fertilizer, however. (Capability unit IIIe-3)

Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, moderately eroded (MrE2).—This undifferentiated soil group contains one, two, or all three soils in various amounts and patterns on the landscape. The soils have been mapped together because their use and management are similar.

The soils of this group are steep and occur in stream-dissected areas. The acreage is limited, but the areas are fairly widespread.

The soils have low available moisture capacity, and a low content of organic matter. Surface runoff is very rapid, and the soils are very highly susceptible to erosion unless adequate vegetation is maintained. (Capability unit VIe-1)

Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, severely eroded (MrE3).—This undifferentiated soil group contains one, two, or all three soils in various amounts and patterns on the landscape. The soils have been

mapped together because their management and use are similar.

The soils of this group are steep and occur in stream-dissected areas. The acreage is limited.

As a result of erosion, the soils have very low available moisture capacity and a low content of organic matter. Most of the upper soil layers have been removed, and calcareous loam till is exposed over much of the areas. Surface runoff is very rapid, and erosion is a severe hazard unless permanent vegetation is maintained. (Capability unit VIe-1)

Miami, Fox, and Hennepin soils, 25 to 50 percent slopes, moderately eroded (MrF2).—This undifferentiated soil group contains one, two, or all three soils in various amounts and patterns on the landscape. The soils have been mapped together because their management and use are similar.

The soils of this group are very steep and occur in stream-dissected areas. The acreage is limited.

The soils have low available moisture capacity and a low content of organic matter. Surface runoff is very rapid, and erosion is a very severe hazard unless permanent vegetation is maintained. (Capability unit VIIe-1)

Miami, Fox, and Hennepin soils, 25 to 50 percent slopes, severely eroded (MrF3).—This undifferentiated soil group contains one, two, or all three soils in various amounts and patterns on the landscape. The soils have been mapped together because their management and use are the same.

The soils of this group are very steep and occur in stream-dissected areas. The acreage is limited.

The soils have very low available moisture capacity and a low content of organic matter. Erosion has removed most of the upper soil layers, and calcareous loam till is exposed over much of the areas. Surface runoff is very rapid, and erosion is a very severe hazard unless permanent vegetation is maintained. (Capability unit VIIe-1)

Millsdale Series

The Millsdale series consists of moderately deep to deep, dark-colored, very poorly drained soils. The soils have formed in moderately fine textured to medium-textured till or outwash under a mantle of loess up to 36 inches thick. Limestone or calcareous clay shale bedrock occurs at depths of 20 to 48 inches. These nearly level to gently sloping soils are in uplands and in depressions on the till plains. They also occupy terraces where the soil is fairly shallow to bedrock. The areas are along Twin Creek and in Somers and Gratis Townships. The native vegetation was a mixed stand of deciduous hardwoods.

The plow layer of a typical Millsdale soil is black, firm silty clay loam. The subsoil, which extends to a depth of about 26 inches, is mottled brown, dark yellowish brown, and yellowish brown. It consists of silty clay, silty clay loam, and clay loam. The yellowish-brown and brown clay loam and loam substratum is mottled with gray. Limestone bedrock or calcareous shale occurs at a depth of about 45 inches.

The Millsdale soils have a high organic-matter content, moderately slow permeability, and high available moisture capacity.

These soils are used for pasture and crops. Wetness is a hazard because of a seasonal high water table. The varying

depths to bedrock in many places limit installation of tile drains. Surface ditches have limited effectiveness.

Technical description of a profile of Millsdale silty clay loam, 0 to 3 percent slopes, in a meadow in Gratis Township, sec. 9, T. 4 N., R. 3 E.:

- Ap—0 to 6 inches, black (10YR 2/1) silty clay loam; moderate, medium, subangular blocky structure; firm; neutral; lower boundary abrupt and smooth.
- A1—6 to 11 inches, black (10YR 2/1) silty clay; moderate, fine, subangular and angular blocky structure; firm; slightly acid; lower boundary clear and wavy.
- B21—11 to 14 inches, brown (10YR 4/3) silty clay; black (10YR 2/1) tongues extend from horizons above; moderate, medium, angular blocky structure; firm; neutral; lower boundary clear and wavy.
- B22g—14 to 17 inches, brown (10YR 4/3) silty clay; black (10YR 2/1) pockets and few, fine, faint, dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, angular and subangular blocky structure; firm; neutral; lower boundary clear and wavy.
- B23tg—17 to 21 inches, dark yellowish-brown (10YR 4/4) silty clay loam; very dark brown (10YR 2/2) pockets; thin, continuous, dark grayish-brown (10YR 4/2) clay coatings; common, medium, faint, yellowish-brown (10YR 5/6 and 5/4) mottles; weak, medium, subangular blocky structure; firm; neutral; many manganese concretions; lower boundary clear and wavy.
- B3tg—21 to 26 inches, yellowish-brown (10YR 5/6) clay loam; very dark brown (10YR 2/2) pockets; thin, discontinuous, dark-gray (10YR 4/1) clay coatings; gray (5Y 6/1) weathered limestone fragments; common, medium, faint, yellowish-brown (10YR 5/4) mottles and few, medium, distinct, dark grayish-brown (10YR 4/2) and grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; neutral; many manganese concretions; lower boundary gradual and wavy.
- C1g—26 to 31 inches, yellowish-brown (10YR 5/4) clay loam; very dark brown (10YR 2/2) pockets; gray (N 6/0) weathered limestone fragments; common, medium, faint, yellowish-brown (10YR 5/6) mottles and few, fine, distinct, gray (5Y 6/1) mottles; weak, medium, subangular blocky structure; friable; slightly calcareous; lower boundary clear and wavy.
- C2—31 to 39 inches, brown (10YR 5/3) loam; very dark brown (10YR 2/2) pockets; gray (N 6/0) weathered limestone fragments; light brownish-gray (10YR 6/2) streaks; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; strongly calcareous; lower boundary diffuse.
- C3—39 to 45 inches, brown (10YR 5/3) loam; gray (N 6/0), weathered limestone fragments; light brownish-gray (10YR 6/2) streaks; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; strongly calcareous; lower boundary abrupt and irregular.
- R—45 inches +, limestone bedrock.

The depth to bedrock in the profile just described is deeper than is typical for the county. The typical depth is about 36 inches. The texture of the surface layer is silt loam and silty clay loam.

The Millsdale soils are the very poorly drained members of a drainage sequence that includes the well-drained Milton and the somewhat poorly drained Randolph soils. They are shallower than the Brookston soils.

Millsdale silt loam, 0 to 3 percent slopes (MsA).—This soil has a profile similar to the one described as representative of the series, but the surface layer and upper subsoil are less clayey. It occupies areas mantled with loess and also areas where silt has washed in from surrounding silt-mantled soils. The more sloping areas occur in broad upland drainageways. Water tends to pond in the depressions. A seasonal high water table and wetness limit the use of this soil. (Capability unit IIIw-1)

Millsdale silty clay loam, 0 to 3 percent slopes (MtA).—Little or no erosion has occurred on this soil. The surface is likely to become cloddy if the soil is plowed or cultivated while wet. The more sloping areas occur in upland drainageways. Water tends to pond in depressions. (Capability unit IIIw-1)

Milton Series

Soils in the Milton series are well drained and moderately deep to deep over limestone. They have formed in a thin layer of wind-deposited material and calcareous loam till over limestone or calcareous shale. These nearly level to sloping soils are on till plains and terraces. They are mostly along Twin Creek and in Somers and Gratis Townships. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Milton silt loam that is cultivated has a 6-inch plow layer of brown silt loam. The subsoil, to a depth of about 20 inches, is dark-brown or brown silt loam or clay loam. The lower part of the subsoil is yellowish-brown loam and contains many till pebbles and some limestone fragments. Limestone bedrock is at a depth of about 31 inches.

These soils have moderately slow permeability and low to moderate available moisture capacity.

The Milton soils are suited to crops commonly grown in the county, but they dry out quickly in summer because of shallowness to bedrock. They need periodic applications of lime and fertilizer.

Technical description of a profile of Milton silt loam in Lanier Township, sec. 22, T. 5 N., R. 3 E.:

- Ap—0 to 6 inches, brown (10YR 4/3) silt loam; moderate, very fine, granular structure; friable; medium acid; lower boundary abrupt and smooth.
- B1—6 to 10 inches, brown (7.5YR 4/4) silt loam; weak, fine, subangular blocky structure; friable; medium acid; lower boundary clear and smooth.
- IIB2t—10 to 20 inches, dark-brown (7.5YR 3/4) clay loam; weak, medium and coarse, subangular blocky structure; firm; some small till pebbles; slightly acid; lower boundary clear and wavy.
- IIB3t—20 to 25 inches, yellowish-brown (10YR 5/4) loam; many dark yellowish-brown (10YR 3/4) clay flows intruding from IIB2t horizon; nearly structureless but breaks along clay flows; firm; contains many till pebbles and some limestone fragments; slightly calcareous; lower boundary abrupt and smooth.
- IIC—25 to 31 inches, gray (5Y 6/1) silty clay loam; massive; firm when moist, hard when dry; contains streaks of pale olive (5Y 6/4); strongly calcareous; lower boundary abrupt and smooth.
- R—31 inches +, limestone bedrock.

Depth to limestone is typically 24 to 32 inches, but the range is from 20 to 42 inches. The texture of the IIB2t horizon ranges from clay loam to silty clay loam and light clay. The part of the B horizons developed from bedrock varies in texture because of differences in the characteristics and composition of the bedrock. The reaction of the B1 and IIB2t horizons is medium acid to slightly acid.

The Milton soils are members of a drainage sequence that includes the somewhat poorly drained Randolph soils and very poorly drained Millsdale soils. They are similar to the Wynn soils but have a thinner layer of silty material over the till.

Milton silt loam, 0 to 2 percent slopes (MuA).—This soil occurs above bedrock escarpments and on broad ridgetops. A small part of it is on stream terraces. Here, the soil has developed from silty and loamy outwash over thin

deposits of stratified gravel and sand, and the surface layer and subsoil resemble those of the Fox soils.

Included with this soil are areas of moderately well drained Celina soils that are too small to be shown separately on the soil map.

The available moisture capacity of this Milton soil is low to moderate, depending on the depth to bedrock. The soil has good tilth and a medium content of organic matter. Surface runoff is slow to medium, and there is little or no hazard of erosion. (Capability unit IIs-1)

Milton silt loam, 2 to 6 percent slopes (MuB).—This soil occurs above bedrock escarpments and on ridgetops. A small part of it is on stream terraces. Here, the soil has developed from silty and loamy outwash over thin deposits of stratified gravel and sand, and the surface layer and subsoil resemble those of the Fox soils.

Included with this soil are some areas of well-drained Miami soils that are too small to be shown separately on the soil map.

The available moisture capacity of this Milton soil is low to moderate, depending on the depth to bedrock. The soil has good tilth and a medium content of organic matter. Surface runoff is medium, and susceptibility to further erosion is slight to moderate. (Capability unit IIe-1)

Milton silt loam, 2 to 6 percent slopes, moderately eroded (MuB2).—This soil occurs on ridgetops and on steeper areas above bedrock outcrops. Erosion has removed part of the original surface layer. The present plow layer is a mixture of the original surface layer and material from the subsoil. A small acreage of this soil is on stream terraces. Here, the soil has developed from silty and loamy outwash over thin deposits of stratified gravel and sand, and the surface layer and subsoil resemble those of the Fox soils.

Included with this soil are areas of well-drained Miami soils that are too small to be shown separately on the soil map.

This Milton soil has a low to medium content of organic matter. The available moisture capacity is low to medium, depending on the depth to bedrock. Tilth is fair. Surface runoff is medium, and susceptibility to further erosion is moderate. (Capability unit IIe-1)

Milton silt loam, 6 to 12 percent slopes, moderately eroded (MuC2).—This soil is mainly along and at the heads of waterways. Erosion has removed part of the original surface layer. The present plow layer is a mixture of the original surface layer and material from the subsoil. A small acreage of this soil is on stream terraces. Here, the soil has developed from silty and loamy outwash over thin deposits of stratified gravel and sand, and the surface layer and subsoil resemble those of the Fox soils.

This soil has low available moisture capacity and a low organic-matter content. Surface runoff is rapid, and susceptibility to further erosion is moderate to high (Capability unit IIIe-1)

Milton soils, 6 to 12 percent slopes, severely eroded (MvC3).—These soils are mainly along and at the heads of waterways. Erosion has removed most of the original surface layer. A small acreage of these soils is on stream terraces. Here, the soils have developed from silty and loamy outwash over thin deposits of stratified sand and gravel, and the surface layer and subsoil resemble those of the Fox soils.

The soils have low available moisture capacity, low organic-matter content, and a shallow root zone. Surface runoff is rapid, and the soils are highly susceptible to further erosion. (Capability unit IVE-2)

Ockley Series

The Ockley series consists of deep well-drained soils formed in silt-mantled glacial outwash underlain by stratified, calcareous gravel and sand. These nearly level to sloping soils are typically on outwash plains and valley trains and on terraces. They are fairly high above the adjacent flood plains. The original native vegetation was a mixed stand of deciduous hardwoods.

A typical cultivated Ockley soil has a dark yellowish-brown silt loam plow layer that is granular and friable. The subsoil, to a depth of 36 inches, is dark-brown silt loam. Below this depth the subsoil is dark-brown sandy clay to dark reddish-brown sandy clay loam to a depth of about 50 inches. Below a depth of 50 inches is loose, calcareous sand and gravel.

These soils have moderate permeability, high available moisture capacity, and medium organic-matter content. The root zone is deep.

The Ockley soils are suited to most of the crops commonly grown in the county.

Technical description of a profile of a nearly level Ockley silt loam in a cultivated field in the NE $\frac{1}{4}$ sec. 31, T. 4 N., R. 3 E:

- Ap—0 to 9 inches, dark yellowish-brown (10YR 3/4) silt loam; moderate, fine and medium, granular structure; slightly acid; friable; lower boundary abrupt and smooth.
- B1—9 to 15 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, subangular blocky structure; friable; medium acid; lower boundary clear and smooth.
- B21t—15 to 22 inches, dark-brown (10YR 4/3) heavy silt loam; yellowish brown (10YR 5/4) when crushed; moderate, medium, subangular and angular blocky structure; firm; strongly acid; lower boundary diffuse.
- B22t—22 to 36 inches, dark-brown (10YR 4/3) heavy silt loam; yellowish brown (10YR 5/4) when crushed; moderate, medium, subangular and angular blocky structure; firm; medium acid; lower boundary abrupt and wavy.
- IIB23t—36 to 43 inches, dark-brown (7.5YR 4/4) sandy clay; moderate, fine and medium, subangular blocky structure; friable; medium acid; lower boundary clear and wavy.
- IIB24t—43 to 50 inches, dark reddish-brown (5YR 3/4) and reddish-brown (5YR 4/4) sandy clay loam; yellowish red (5YR 4/6) when crushed; weak, fine and medium, subangular blocky structure; friable; slightly acid; lower boundary abrupt and wavy.
- IIIC1—50 to 64 inches, calcareous, loose sand and gravel; many pebbles 1 inch to 3 inches in diameter.

The silt mantle is as much as 36 inches thick. The color of the Ap horizon ranges from dark yellowish brown (10YR 3/4) to dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2).

The texture of the upper B horizons is heavy silt loam or silt loam. The texture of the lower B horizons ranges from clay loam to gravelly or sandy clay loam.

The underlying materials are stratified sand and gravel that in a few places are interspersed with layers of loamy material. The loamy material occurs where these terrace soils adjoin soils of the uplands.

The Ockley soils are commonly next to the Fox soils, which are shallower to sand and gravel; Wea and Warsaw soils, which are darker colored; and Kendallville soils, which are underlain by calcareous till instead of sand and gravel.

Ockley silt loam, 0 to 2 percent slopes (OcA).—This soil occurs on benches above the breaks between the bottom-land and terrace soils. It is also on outwash plains.

Included with this soil are a few areas of the moderately well drained Thackery soils that are too small to be shown separately on the soil map. Also included are areas that are underlain by sandy loam or loam instead of sand and gravel; most of these areas occur where this terrace soil grades to soils of the uplands.

This Ockley soil has good tilth. Surface runoff is slow to medium, and the risk of erosion is slight. (Capability unit I-1)

Ockley silt loam, 2 to 6 percent slopes (OcB).—This soil occurs on benches above the breaks between the first-bottom and terrace soils. It is also on outwash plains.

Included with this soil are a few areas of the moderately well drained Thackery soils that are too small to be shown separately on the soil map. Also included are areas that are underlain by sandy loam or loam instead of sand and gravel; most of these areas occur where this terrace soil adjoins soils of the uplands. Other included areas are moderately eroded.

This Ockley soil has good tilth. Surface runoff is medium, and the risk of erosion is moderate when the soil is cultivated. (Capability unit IIe-1)

Ockley and Kendallville silt loams, 0 to 2 percent slopes (OkA).—The soils of this undifferentiated group are on glacial outwash plains where the outwash material is thin over the underlying calcareous till. They are also on local kames. A few areas are in the boulder belt shown on the general soil map. Both soils are typical of their series, except that the Ockley soil has a substratum of calcareous loam till.

These soils are well suited to cultivation. If cultivated, they have little or no hazard of erosion. (Capability unit I-1)

Ockley and Kendallville silt loams, 2 to 6 percent slopes (OkB).—These soils are similar to Ockley and Kendallville silt loams, 0 to 2 percent slopes, except for steeper slopes. They are suited to cultivation but have a moderate hazard of erosion. (Capability unit IIe-1)

Ockley and Kendallville silt loams, 2 to 6 percent slopes, moderately eroded (OkB2).—These soils have profiles similar to those described for the Ockley and Kendallville series, but their surface layer is thinner as a result of erosion. Also, the Ockley soil has a substratum of calcareous loam till that is not typical of the series.

Because of erosion, these soils have a reduced available moisture capacity. If cultivated, they have a moderate hazard of erosion. (Capability unit IIe-1)

Ockley and Kendallville silt loams, 6 to 12 percent slopes, moderately eroded (OkC2).—These soils are similar to Ockley and Kendallville silt loams, 0 to 2 percent slopes, but, because of erosion, they have a thinner surface layer and plow layer. Also, they have lower available moisture capacity.

These soils can be cultivated, but erosion is a severe hazard. (Capability unit IIIe-1)

Ockley and Kendallville silt loams, 12 to 18 percent slopes, moderately eroded (OkD2).—Because of erosion, these moderately steep soils have a thinner plow layer than the typical soils of the Ockley and Kendallville series.

If cultivated, the soils have a very severe hazard of erosion. Because they are fairly thin over calcareous till and are moderately steep, they have a low to moderate available moisture capacity and tend to be droughty. (Capability unit IVe-1)

Ockley and Kendallville soils, 6 to 12 percent slopes, severely eroded (OIC3).—These sloping soils occur on outwash plains where the outwash is thin over calcareous till and on local kames. Most of the original silt loam surface layer has eroded away. The present surface layer is sticky when wet, and, because of erosion, it is hard to till. If cultivated, these soils are subject to very severe erosion. (Capability unit IVe-2)

Ockley and Kendallville soils, 12 to 18 percent slopes, severely eroded (OID3).—These soils are moderately deep to calcareous loam till, but they are too steep and too severely eroded to be cultivated. Their surface layer is sticky and has poor tilth. These soils have a severe hazard of further erosion if permanent vegetation is not maintained. (Capability unit VIe-1)

Odell Series

The Odell series consists of dark-colored soils that are somewhat poorly drained. The soils have formed in calcareous loam till that has a mantle of loess up to 18 inches thick. They are moderately deep to till. These gently sloping soils are in the uplands. The native vegetation was a mixture of prairie grasses, swamp grasses, and scattered deciduous hardwoods.

A typical cultivated Odell soil has a very dark grayish-brown silt loam plow layer that is friable. The upper part of the subsoil is dark brown silty clay loam. The lower part is dark grayish-brown and yellowish-brown clay loam. The entire soil mass from a depth of about 8 inches downward is mottled with various colors. At a depth of about 36 inches, there is calcareous silty clay loam till that is fairly compact.

The Odell soils have a high organic-matter content, have high available moisture capacity, and have moderately slow permeability in the lower subsoil and underlying till. They have a moderately deep root zone.

If adequately drained, the Odell soils are suited to cultivation.

Technical description of a profile of Odell silt loam in an area 7 miles south and 4½ miles west of Eaton in Israel Township, sec. 1, T. 6 N., R. 1 E. (Sample PB-13 in laboratory analyses):

- Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; same color when crushed; weak, fine to coarse, granular structure; friable; organic-matter content fairly high; roots abundant; slightly acid; lower boundary abrupt.
- B1—7 to 12 inches, dark-brown (10YR 3/3) silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; roots abundant; neutral; lower boundary gradual.
- B2t—12 to 19 inches, dark-brown (10YR 4/3) clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; grayish-brown (10YR 5/2) clay films on ped surfaces; weak, medium, subangular blocky structure; friable; many small manganese concretions; neutral; roots abundant; lower boundary gradual.

B2t—19 to 27 inches, dark grayish-brown (10YR 4/2) clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; grayish-brown (10YR 5/2) clay films on ped surfaces; moderate, medium, subangular blocky structure; many small manganese concretions; firm; neutral; many roots; lower boundary clear.

B3t—27 to 36 inches, yellowish-brown (10YR 5/6) clay loam; ped surfaces covered with grayish-brown (10YR 5/2) clay films; weak to moderate, subangular blocky structure; few small manganese concretions; friable; mildly alkaline; lower boundary clear.

C1—36 to 46 inches, yellowish-brown (10YR 5/4) light silty clay loam till; yellowish-brown (10YR 5/6 to 5/8) and grayish-brown (10YR 5/2) streaks; massive in place; many till pebbles and limestone fragments; slightly calcareous.

C2—46 to 60 inches, yellowish-brown (10YR 5/4) light silty clay loam till; streaks of yellowish brown (10YR 5/8) and grayish brown (10YR 5/2); massive in place; many till pebbles and limestone fragments; strongly calcareous.

The A horizon is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2). Depth of mottling ranges from 6 to 12 inches and generally begins at the bottom of the A horizon. The A horizon is medium acid to neutral. Depth to calcareous till ranges from about 22 to 40 inches.

The Odell soils are adjacent to the Crosby, Brookston, and Celina soils. They are similar to the Crosby soils but are darker colored. They are darker colored and more poorly drained than the Miami soils, and they are better drained than the Brookston soils. The Odell soils differ from the Raub soils in that they are slightly shallower to till material and have a thinner mantle of loess.

Odell silt loam, 2 to 6 percent slopes (OsB).—This soil occupies slightly higher elevations around the Brookston soils in the depressions. It has some boulders where it occurs in the boulder belt shown on the general soil map.

Included with this soil are some small areas of light-colored Crosby soils and a few areas of Brookston soils.

Surface runoff from this Odell soil is slow to moderate, and tilth of the plow layer is generally very good. Wetness and moderately slow permeability are continuing limitations, even if this soil is adequately drained. (Capability unit IIw-2)

Plattville Series

The Plattville series consists of moderately deep to deep, well-drained, dark-colored soils. The soils have formed in silt-mantled calcareous till or silt-mantled outwash deposits that are underlain by limestone or calcareous shale bedrock. They are nearly level and gently sloping and occur in uplands and on terraces. The native vegetation was a mixed stand of prairie grasses and scattered deciduous hardwoods.

A typical cultivated Plattville soil has a very dark grayish-brown or black surface layer of granular silt loam. It has a thin upper subsoil layer of very dark brown silty clay loam. Most of the subsoil consists of yellowish-brown clay loam. This is underlain by a thin layer of calcareous till material. This material overlies limestone bedrock that occurs at a depth of about 40 inches.

The Plattville soils have moderately slow permeability. They have a high organic-matter content and low to medium available moisture capacity. They have good tilth and a moderately deep root zone.

The Plattville soils are suitable for most crops commonly grown in the county.

Technical description of a profile of a gently sloping Plattville silt loam in a cultivated field in Gratis township:

- Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, granular structure; friable; neutral; lower boundary abrupt and smooth.
- A12—7 to 10 inches, black (10YR 2/1) fine silt loam; strong, very fine and fine, subangular blocky structure; friable; neutral; lower boundary clear and smooth.
- B1—10 to 13 inches, very dark brown (10YR 2/2) silty clay loam; black (10YR 2/1) coatings and organic stains on ped surfaces; strong, fine and medium, subangular blocky structure; firm; neutral; lower boundary clear and smooth.
- B21t—13 to 18 inches, yellowish-brown (10YR 5/4) silty clay loam; dark-brown (10YR 4/3) and very dark grayish-brown (10YR 3/2) organic stains on ped faces; moderate, fine and medium, subangular blocky structure; firm; neutral; lower boundary clear and smooth.
- B22t—18 to 23 inches, yellowish-brown (10YR 5/4) clay loam; very dark grayish-brown (10YR 3/2) tongues extend from the B21t horizon; moderate, medium and coarse, subangular blocky structure; firm; neutral; lower boundary clear and smooth.
- B23t—23 to 30 inches, yellowish-brown (mixed 10YR 5/4, 5/6, and 5/8) clay loam; dark-brown (10YR 3/3) tongues extend from horizon above; weak, coarse, subangular blocky structure; firm; pH 7.2; lower boundary clear and smooth.
- B3—30 to 38 inches, yellowish-brown (10YR 5/4 and 5/6) coarse clay loam; dark-brown (10YR 3/3) tongues extend from horizon above; massive in place, but breaks along weak structural faces when disturbed; friable; slightly calcareous; lower boundary clear and smooth.
- HC1—38 to 40 inches, yellowish-brown (mixed 10YR 5/4 and 5/6) and pale-olive (5Y 6/3) silty clay loam; massive; firm; calcareous; lower boundary abrupt and smooth.
- R—40 inches +, limestone bedrock.

Depth to bedrock is variable over short distances and ranges from about 20 to 48 inches. Where these soils have developed in outwash material, the B horizons contain more sand and gravel and the texture of the B2 horizons is generally sandy or gravelly clay loam. Where they are underlain by clay shale, the profile is deepest and the lower B2 horizons contain their highest content of clay. Because of this high clay content, the lower B2 horizons are very plastic when wet.

The Plattville soils are similar to the Corwin and Dana soils but are better drained and have limestone bedrock within 48 inches of the surface. They are deeper and darker colored than the adjacent Wynn and Milton soils.

Plattville silt loam, 2 to 6 percent slopes (PIB).—Included with this soil are some small areas of the Milton and Wynn soils and some areas of moderately well drained Corwin and Dana soils.

This Plattville soil has good tilth and is easy to till. Erosion is a hazard when it is cultivated, however. (Capacity unit IIe-1)

Pyrmont Series

The Pyrmont series consist of somewhat poorly drained soils formed in calcareous loam till of the Wisconsin age. These nearly level to gently sloping soils are in uplands west of Eldorado and southeast of Lewisburg, along the Preble and Montgomery County line. The native vegetation was a mixed stand of beech, maple, oak, elm, and other deciduous hardwoods.

The plow layer of a typical cultivated Pyrmont soil is dark grayish-brown, friable silt loam. The clay loam subsoil is firm and is grayish brown to brown. The soil

is mottled directly below the plow layer; grayish mottles occur at the lower depths. The substratum, at a depth of about 16 inches, is firm loam till.

The plow layer has low organic-matter content, and tilth is generally poor. The subsoil and substratum have moderately slow permeability. The available moisture capacity in the root zone is low. When these soils are drained, the root zone is limited by shallowness to the compact till substratum.

Most of the acreage of these soils is farmed. Crops common to the area and tolerant of wet soils are grown. The soils have high natural fertility, and crops respond well to fertilizer. The major hazard is wetness. Where the soils are gently sloping, erosion is a secondary hazard.

Technical description of a profile of Pyrmont silt loam, 0 to 2 percent slopes, in a meadow in Twin Township, sec. 1, T. 6 N., R. 3 E. (Sample PB-40 in laboratory analyses):

- Ap—0 to 7 inches, dark grayish-brown (2.5Y 4/2) silt loam; weak, fine and medium, granular structure; friable; medium acid; lower boundary abrupt and smooth.
- B1g—7 to 10 inches, grayish-brown (10YR 5/2) silt loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine and medium, subangular blocky structure; friable; slightly acid; lower boundary abrupt and smooth.
- B2tg—10 to 13 inches, grayish-brown (10YR 5/2) and dark grayish-brown (10YR 4/2) fine clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) and common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine and medium, angular blocky structure; thin, patchy clay films on ped surfaces; firm; neutral; lower boundary clear and wavy.
- B3t—13 to 16 inches, brown (10YR 4/3) clay loam; common, fine, distinct, grayish-brown (10YR 5/2) and dark yellowish-brown (10YR 4/4) mottles and very dark grayish-brown (10YR 3/2) clay flows; moderate, fine and medium, angular and subangular blocky structure; thin, patchy clay films on ped surfaces; firm; neutral; lower boundary clear and wavy.
- C1—16 to 24 inches, loam that is brown (10YR 5/3) when crushed; common, medium, distinct, dark yellowish-brown (10YR 4/4) and common, medium, faint, dark grayish-brown (10YR 4/2) mottles; very dark grayish-brown (10YR 3/2) clay flows; massive; very firm in place; horizon is dense; strongly calcareous; lower boundary gradual.
- C2—24 to 32 inches, brown (10YR 4/3) loam; few, fine, distinct yellowish-brown (10YR 5/6) mottles and light-gray (10YR 7/2) and grayish-brown (10YR 5/2) seams that have a high content of carbonate; massive; extremely firm in place; horizon is very dense; strongly calcareous; lower boundary gradual.
- C3—32 to 37 inches, light olive-brown (2.5Y 5/4) loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles and light brownish-gray (10YR 6/2) carbonate seams; massive; strongly calcareous; bucket auger sample.
- C4—37 to 60 inches, dark yellowish-brown (10YR 4/4) loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles and light brownish-gray (10YR 6/2) carbonate seams; massive; strongly calcareous.

The depth to calcareous till is fairly variable over short distances. In most places it is less than 15 inches, but the range is from 11 to 17 inches. A thin A2 horizon generally occurs in uncultivated areas. The surface layer is dark grayish brown (2.5Y 4/2) or dark grayish brown (10YR 4/2). The reaction ranges from medium acid to neutral in the Ap horizon. The pH increases with depth.

The Pyrmont soils are near the higher lying, moderately well drained Lewisburg soils. They are shallower to calcareous till than the Crosby soils, and the till is more compact.

Pyrmont silt loam, 0 to 2 percent slopes (PyA).—This soil occupies broad areas between drainage ways and areas surrounding lower lying Brookston soils.

Included with this soil are some areas of very poorly drained Brookston soils and moderately well drained to well drained Lewisburg soils that are too small to be shown separately on the soil map.

Wetness is a continuing limitation, even if this Pymont soil is drained. (Capability unit IIw-2)

Pymont silt loam, 2 to 6 percent slopes (PyB).—This soil is gently sloping and surrounds lower lying Brookston soils of the depressions. Also, it occupies slopes between drainageways.

Included with this soil are some areas of moderately well drained to well drained Lewisburg soils and very poorly drained Brookston soils that are too small to be shown separately on the soil map.

Wetness is a continuing limitation, even if this Pymont soil is drained. Erosion is also a hazard, particularly on the steeper areas. (Capability unit IIw-2)

Quarries

Quarries (Qu) is a miscellaneous land type. The soil layers have been removed in order to mine the limestone bedrock. The only quarry now operating in the county is northwest of Lewisburg, where bedrock of the Brassfield formation is being mined.

Large quarries are outlined on the soil map. Small quarries are shown by a special symbol for quarries. (Capability unit VIIIIs-1)

Ragsdale Series

Soils of the Ragsdale series are deep, nearly level, very poorly drained, and dark colored. They have formed in calcareous or neutral silt deposits that overlie calcareous glacial till. They occupy depressions and uplands in the area known as the Boston Plains. The native vegetation was a mixed stand of deciduous hardwoods.

A typical cultivated Ragsdale soil has a friable surface layer that is about 10 inches thick. It is very dark grayish brown silt loam in the upper part and very dark brown silty clay loam in the lower part. The subsoil is mostly dark-gray silty clay loam. At a depth of about 46 inches, there is calcareous till material that is yellowish brown and loamy.

The Ragsdale soils have high organic-matter content, high available moisture-capacity, and moderately slow permeability.

When adequately drained, the Ragsdale soils are suited to most crops grown in the country.

Technical description of a profile of Ragsdale silt loam in a cultivated field in Jackson Township, NW $\frac{1}{4}$ sec. 30, T. 8 N., R. 1 E.:

- Ap1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine and medium, granular structure; friable; medium acid; lower boundary abrupt and smooth.
- Ap2—4 to 10 inches, very dark brown (10YR 2/2) silty clay loam; moderate, fine and medium, angular blocky structure; friable; medium acid; lower boundary abrupt and wavy.
- B1g—10 to 15 inches, dark-gray (10YR 4/1) and gray (10YR 5/1) silty clay loam; many, fine and medium, distinct, yellowish-brown (10YR 5/6), mottles; moderate, medium, subangular blocky structure; firm; dark-brown (10YR 3/3) clay films extend into this horizon from

the Ap2 horizon; slightly acid; lower boundary clear and smooth.

- B21tg—15 to 20 inches, dark-gray (10YR 4/1) silty clay loam; many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm; slightly acid; lower boundary clear and smooth.
- B22tg—20 to 25 inches, dark-gray (10YR 4/1) clay loam; few, medium, distinct, black (10YR 2/1) mottles and many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; dark-brown (10YR 3/3) fillings in crawfish holes; slightly acid; lower boundary clear and smooth.
- B23tg—25 to 29 inches, gray (N 5/0) silty clay loam; few, medium, distinct, dark-gray (N 4/0) mottles and many, fine and medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; moderate, medium, subangular blocky structure; friable; dark grayish-brown (10YR 4/2) fillings in crawfish holes; neutral; lower boundary abrupt and wavy.
- B31g—29 to 37 inches, gray (N 5/0) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; dark grayish-brown (10YR 4/2) fillings in crawfish holes; neutral; lower boundary gradual.
- B32g—37 to 46 inches, gray (N 5/0) silty clay loam; many, medium and coarse, distinct, yellowish-brown (10YR 5/8) mottles throughout the matrix and in pockets of high silt content; weak, medium, subangular blocky structure; friable; dark grayish-brown (10YR 4/2) fillings in crawfish holes; neutral; lower boundary gradual.
- IIC1g—46 to 51 inches, yellowish-brown (10YR 5/6) silt loam; many, coarse, distinct, gray (N 5/0) mottles and few, fine, faint, yellowish-brown (10YR 5/8) mottles; massive; friable; slightly calcareous.
- IIC2g—51 to 74 inches, a mixture of yellowish-brown (10YR 5/8), gray (10YR 5/1), and dark yellowish-brown (10YR 4/4) loam; massive; strongly calcareous.

The total thickness of the A horizon ranges from 10 to about 15 inches. The A horizon is medium acid to slightly acid. The pH increases with increasing depth in the solum. The silt mantle is from 40 to about 75 inches thick. Calcareous till occurs just below the silt.

The Ragsdale soils are adjacent to the somewhat poorly drained Reesville soils and moderately well drained Birkbeck soils. They are similar to nearby Brookston soils but have a thicker mantle of silt.

Ragsdale silt loam (Ra).—This nearly level soil occurs in broad areas and in depressions near the Reesville and Birkbeck soils on the Boston Plains.

Small areas of Brookston soils are included where this soil has glacial till within 40 inches of the surface. Also included are areas that have a coarse silty clay loam surface layer.

Artificial drainage is needed on Ragsdale silt loam. It can be easily installed where tile or surface outlets are available. Seasonal wetness and moderately slow permeability are continuing limitations, even when the soil is drained, however. (Capability unit IIw-4)

Randolph Series

The Randolph series consists of nearly level to gently sloping, somewhat poorly drained soils. The soils have formed in fairly thin, calcareous glacial till that is mantled with silt and underlain by limestone bedrock. They occupy uplands, and some areas are near Twin Creek. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Randolph soil in a wooded area has a very dark grayish-brown upper surface layer that contains abundant roots. The rest of the surface layer, to a depth of

about 10 inches, is pale-brown and brown silt loam, distinctly mottled with yellowish-brown. The subsoil is mostly dark yellowish-brown clay loam mottled with dark gray and light brownish gray. Below the subsoil, there is calcareous till material to a depth of about 36 inches. Below the till is level-bedded limestone bedrock.

The Randolph soils are low to medium in organic-matter content, are moderate to low in available moisture capacity, and have moderately slow permeability.

Drained areas of Randolph soils are used for crops that tolerate some wetness.

Technical description of a profile of Randolph silt loam in a wooded area in Lanier Township, SE $\frac{1}{4}$ sec. 16, T. 5 N., R. 3 E.:

- A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, granular structure; friable; roots abundant; very strongly acid; lower boundary clear and smooth.
- A21—3 to 5 inches, brown (10YR 5/3) and pale-brown (10YR 6/3) silt loam; very dark grayish-brown (10YR 3/2) fillings along and in root channels; moderate, medium, platy structure; very friable; roots abundant; extremely acid; lower boundary clear and smooth.
- A22—5 to 7 inches, pale-brown (10YR 6/3) silt loam; few, medium, distinct, yellowish-brown (10YR 5/4) mottles; very dark grayish-brown (10YR 3/2) fillings along and in root channels; moderate, medium, platy structure; friable; roots abundant; extremely acid; lower boundary abrupt and smooth.
- A3—7 to 10 inches, brown (10YR 5/3) silt loam; common, medium, distinct, yellowish-brown (10YR 5/6) and common, fine, distinct, light brownish-gray (10YR 6/2) mottles; dark grayish-brown (10YR 4/2) fillings along and in root channels; weak, medium, subangular blocky structure; friable; roots plentiful; very strongly acid; lower boundary clear and smooth.
- B1—10 to 14 inches, pale-brown (10YR 6/3) silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and common, fine, distinct, yellowish-brown (10YR 5/6) mottles; dark-gray (10YR 4/1) fillings along and in root channels that extend downward from the A3 to the IIC horizon; moderate, fine and medium, subangular blocky structure; friable; roots plentiful; very strongly acid; lower boundary abrupt and smooth.
- IIB21t—14 to 18 inches, dark yellowish-brown (10YR 4/4) silty clay; common, medium, distinct, light brownish-gray (10YR 6/2) and few, fine, faint, yellowish-brown (10YR 5/6) mottles; brown (10YR 4/3) coatings on ped surfaces; moderate, medium, angular and subangular blocky structure; firm; roots plentiful; very strongly acid; lower boundary diffuse.
- IIB22t—18 to 22 inches, dark yellowish-brown (10YR 4/4) clay loam; common, medium, distinct, brown (10YR 5/3) and light brownish-gray (10YR 6/2) mottles and few, fine, faint, yellowish-brown (10YR 5/6) mottles; brown (10YR 4/3) coatings on ped surfaces; moderate, medium, subangular blocky structure; firm; few roots; strongly acid; lower boundary clear and smooth.
- IIB3t—22 to 24 inches, dark yellowish-brown (10YR 4/4) clay loam; few, medium, distinct, dark-gray (10YR 4/1) and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; dark grayish-brown (10YR 4/2) coatings on structural faces; weak, medium, subangular blocky structure; firm; few roots; slightly calcareous; lower boundary abrupt and smooth.
- IIC1—24 to 30 inches, mixed grayish-brown (10YR 5/2), yellowish-brown (10YR 5/6), and brown (10YR 4/3) loam; weak subangular blocky structure; friable; few roots; weathered limestone fragments; strongly calcareous.
- IIC2—30 to 33 inches, mixed light brownish-gray (10YR 6/2), yellowish-brown (10YR 5/6), and brown (10YR 4/3) sandy loam; massive; friable; few weathered limestone fragments; strongly calcareous.

IIC3—33 to 36 inches, brown (10YR 4/3) loam till, common, medium, distinct, yellowish-brown (10YR 5/6) mottles; light brownish-gray (10YR 6/2) seams throughout the mass; massive; friable; few weathered limestone fragments; strongly calcareous.

R—36 inches +, level-bedded limestone bedrock.

The color of the surface layer of this profile is typical for these soils in areas of permanent vegetation. In cultivated areas the color ranges from very dark grayish brown (10YR 3/2) to brown (10YR 5/3) and grayish brown (10YR 5/2).

The surface layer ranges from extremely acid to slightly acid, and the B horizon ranges from very strongly acid to neutral. The texture of the B2 horizon ranges from silty clay loam and clay loam to clay.

Depth to the C horizon ranges from 20 to 35 inches. The thickness of the C horizon is variable. This horizon is very thin where the depth to bedrock is about 20 inches. In some of these places there is no C horizon.

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

The Randolph soils differ from the Fincastle soils in that they have a thinner mantle of silt and are underlain by limestone.

Randolph silt loam, 0 to 2 percent slopes (RcA).—This soil occurs on broad ridgetops of hills underlain by limestone and calcareous shale. Included with it are a few areas of somewhat poorly drained Crosby and very poorly drained Millsdale soils that are too small to be shown separately on the soil map.

This Randolph soil has a moderately deep root zone. It has fair to poor tilth. Because it is nearly level, surface runoff is slow. Wetness is a continuing hazard, even when this soil is drained. (Capability unit IIIw-1)

Randolph silt loam, 2 to 6 percent slopes (RcB).—This soil occurs on ridgetops and at the heads of waterways on hills underlain by limestone and calcareous shale. Included with it are a few areas of the moderately well drained Celina soils that are too small to be shown separately on the soil map.

This soil has a moderately deep root zone. It has fair to poor tilth. Surface runoff is slow to medium. This soil is susceptible to erosion, particularly the stronger slopes. Wetness is a continuing limitation, even when the soil is drained. (Capability unit IIIw-1)

Raub Series

Soils in the Raub series are somewhat poorly drained and dark colored. They have formed in silt-mantled calcareous loam till. These deep, nearly level to gently sloping soils of the uplands are in Israel, Dixon, and Jackson Townships. The native vegetation was a mixed stand of prairie grasses, swamp grasses, and scattered deciduous hardwoods.

A typical cultivated Raub soil has a plow layer in the upper part of a very dark gray or black silt loam surface layer. The dark color extends down into the upper part of the subsoil to a depth of about 20 inches. The most clayey part of the subsoil consists of yellowish-brown silty clay loam. The lower part of the subsoil is yellowish-brown loam. It is underlain at a depth of about 46 inches by calcareous loam till material.

The Raub soils have high organic-matter content and high available moisture capacity. Permeability is moderately slow in the subsoil and underlying till material.

The Raub soils can be cultivated if they are adequately drained. When drained, they have a deep root zone.

Technical description of a profile of a nearly level Raub silt loam in a cultivated field in SE $\frac{1}{4}$ sec. 6, T. 6 N., R. 1 E. (Sample PB-12 in laboratory analyses) :

- Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; very dark grayish brown (10YR 3/2) when crushed; moderate, fine to medium, granular structure; organic-matter content fairly high; friable; roots abundant; medium acid; lower boundary abrupt and smooth.
- A1—8 to 12 inches, very dark gray (10YR 3/1) to black (10YR 2/1) silt loam; very dark brown (10YR 2/2) when crushed; moderate, fine to medium, subangular blocky structure; friable; roots abundant; medium acid; lower boundary clear.
- A3—12 to 17 inches, black (10YR 2/1) to very dark gray (10YR 3/1) silty clay loam; very dark brown (10YR 2/2) when crushed; moderate, fine to medium, subangular blocky structure; friable; many roots; slightly acid; lower boundary gradual and wavy.
- B1—17 to 20 inches, very dark gray (10YR 3/1) silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine to medium, subangular to angular blocky structure; friable to firm; few roots; slightly acid; lower boundary gradual.
- B21t—20 to 26 inches, yellowish-brown (10YR 5/6) silty clay loam; dark brown (10YR 4/3) when crushed; common, medium, distinct, dark-brown (10YR 3/3) mottles; dark, fairly thick clay flows along ped surfaces; moderate, medium, subangular blocky structure; firm; few roots; slightly acid; lower boundary gradual.
- B22t—26 to 36 inches, yellowish-brown (10YR 5/4) silty clay loam; yellowish brown (10YR 5/6) when crushed; dark grayish-brown (10YR 4/2), thin clay films on peds; moderate, medium to coarse, subangular blocky structure; firm; few roots; neutral; lower boundary gradual.
- 11B3t—36 to 46 inches, yellowish-brown (10YR 5/6) loam; yellowish brown (10YR 5/6) when crushed; dark-brown (10YR 4/3), thin clay films on peds; weak, coarse, subangular blocky structure; few roots; neutral; lower boundary gradual.
- 11C1—46 to 56 inches, yellowish-brown (10YR 5/4 to 10YR 5/6) loam; a few pockets of coarse sand; some till pebbles and limestone fragments; massive; slight effervescence; lower boundary diffuse.
- 11C2—56 to 66 inches, yellowish-brown (10YR 5/4) loam; massive; many till pebbles; strong effervescence.

The silt mantle is 18 to 40 inches thick. Depth to mottling ranges from about 12 to 18 inches and generally begins at the lower boundary of the A horizon. The Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). It is medium acid to neutral.

Typically, the upper B horizons have formed in loess, and the lower B horizons, in till material. Depth to calcareous loam till ranges from about 36 to 60 inches.

The Raub soils occupy areas between the Fincastle and Brookston soils. They are darker colored than the Fincastle soils, and they are not so wet and poorly drained as the Brookston soils. They are more poorly drained than the Dana soils, however.

Raub and Dana silt loams, 0 to 2 percent slopes (RdA).—This mapping unit occupies areas both adjacent to and surrounding depressions and drainageways. The Raub soil is somewhat poorly drained and occurs in the lower areas. The Dana soil is moderately well drained and occurs on the low knolls and higher areas.

Included with this mapping unit are a few small areas of a Brookston soil and a few areas where the soil has slopes of slightly more than 2 percent.

Practically all areas of this mapping unit need to be drained. Those few areas that do not normally require drainage can be farmed intensively. (Raub soil, capability unit IIw-2; Dana soil, capability unit I-1)

Reesville Series

The Reesville series consists of deep, somewhat poorly drained soils that have formed in neutral to calcareous loess. The loess is 40 to 85 inches thick, and it overlies calcareous loam till of the Wisconsin age. These nearly level soils occur in uplands in the Boston Plains west of Eaton along the State line.

The plow layer of a typical cultivated Reesville soil consists of dark grayish-brown, friable silt loam. The subsoil is mainly brown, friable silty clay loam. Mottling and coatings of various shades of gray occur throughout the subsoil. At a depth of about 36 inches is the substratum of brown and grayish-brown, friable, calcareous silt loam.

The Reesville soils have medium organic-matter content. The lower part of the subsoil, the most restrictive layer, has moderately slow permeability. Generally, the root zone is moderately deep. Its depth depends on the effective depth of drainage. The available moisture capacity is high, and natural fertility is also high.

Most of the acreage of these soils is farmed. Corn, wheat, soybeans, and other crops common to the area are grown. Wetness is the major hazard.

Technical description of a profile of uncultivated Reesville silt loam, 0 to 2 percent slopes, in a recently cleared woodlot in Jackson Township, SW $\frac{1}{4}$ of sec. 30, T. 8 N., R. 1 E.:

- A1—0 to 3 inches, black (10YR 2/1) silt loam; very dark brown (10YR 2/2) when crushed; weak, thin, platy structure in place but breaks to weak, fine, granular; very friable; abundant roots; slightly acid; lower boundary smooth and abrupt.
- A2—3 to 8 inches, brown (10YR 4/3) silt loam; dark grayish-brown (10YR 4/2) coatings on ped surfaces; many black (10YR 2/1) fillings in worm channels extend into this horizon from the A1 horizon; weak, medium, subangular blocky structure that breaks to fine granular; friable; abundant roots; slightly acid; lower boundary clear and smooth.
- B1t—8 to 11 inches, brown (10YR 4/3) silty clay loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; very dark grayish-brown (10YR 3/2) coatings on ped surfaces; moderate, medium, angular and subangular blocky structure; friable; plentiful roots; many manganese concretions; slightly acid; lower boundary clear and smooth.
- B21t—11 to 18 inches, brown (10YR 4/3) silty clay loam; common, fine, faint, dark yellowish-brown (10YR 4/4) mottles; very dark grayish-brown (10YR 3/2) ped coatings and fillings in root channels throughout horizon; moderate, medium, subangular blocky structure; friable; plentiful roots; many manganese concretions; slightly acid; lower boundary diffuse.
- B22t—18 to 24 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) and few, fine, distinct, yellowish-brown (10YR 5/8) mottles; very dark grayish-brown (10YR 3/2) coatings on ped surfaces; moderate, medium, subangular blocky structure; friable; plentiful roots; many manganese concretions; neutral; lower boundary diffuse.
- B23t—24 to 30 inches, brown (10YR 4/3) silty clay loam; common, medium, distinct, dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/6 and 5/8) mottles; very dark grayish-brown (10YR 3/2) coatings on ped surfaces; moderate, medium, subangular blocky structure; friable; plentiful roots; many manganese concretions; neutral; lower boundary clear and smooth.
- B3t—30 to 36 inches, brown (10YR 4/3) silt loam; common, medium, distinct, dark grayish-brown (10YR 4/2),

grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/6 and 5/8) mottles; discontinuous very dark grayish-brown (10YR 3/2) coatings on ped surfaces; somewhat massive in place, but breaks along weak structural faces; friable; few roots; many manganese concretions; neutral; lower boundary clear and smooth.

- C1—36 to 44 inches, brown (10YR 4/3) silt loam; common, medium, distinct, dark grayish-brown (10YR 4/2), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/6 and 5/8) mottles; discontinuous very dark grayish-brown (10YR 3/2) ped coatings and fillings in worm channels; massive; friable; many manganese concretions; slightly calcareous; lower boundary diffuse.
- C2—44 to 50 inches, mixed grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4 and 5/8) silt; a few discontinuous very dark grayish-brown (10YR 3/2) ped coatings and fillings in root and worm channels; massive; few manganese concretions; slightly calcareous; lower boundary clear and wavy.
- C3—50 to 59 inches, mixed grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4 and 5/8) silt loam; a few discontinuous very dark grayish-brown (10YR 3/2) fillings in worm casts and root channels; massive; strongly calcareous; lower boundary diffuse.
- C4—59 to 68 inches, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4 and 5/8) silt loam; massive; a few small angular igneous and limestone till pebbles; strongly calcareous; lower boundary diffuse.
- C5—68 to 76 inches, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4 and 5/8) compact silt; massive; a few small angular igneous and limestone till pebbles; strongly calcareous; lower boundary abrupt and wavy.
- IIC6—76 to 86 inches, dark yellowish-brown (10YR 4/4) gravelly sandy loam till; water-worked igneous and limestone pebbles, $\frac{1}{4}$ inch to 3 inches in diameter, make up 10 percent of soil mass; strongly calcareous; lower boundary clear and smooth.
- IIC7—86 to 92 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam; water-worked igneous and limestone pebbles, $\frac{1}{4}$ inch to 3 inches in diameter, make up 10 percent of soil mass; strongly calcareous.
- IIC8—92 to 103 inches, brown (10YR 4/3) loam till; pockets of dark grayish-brown (10YR 4/2) gravelly sandy loam; water-worked igneous and limestone pebbles, $\frac{1}{4}$ inch to $1\frac{1}{2}$ inches in diameter, make up about 10 percent of soil mass; strongly calcareous.

This profile has developed in 76 inches of loess and is deeper than the profile typical for most of the Reesville soils in Preble County. The thickness of the loess is 50 to 60 inches in most places, but the total range is 40 to 85 inches.

In cultivated areas the color of the plow layer ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2).

The reaction of the A horizon ranges from medium acid to slightly acid. The texture of the lower B horizon ranges from silty clay loam to fine silt loam. Depth to carbonates is commonly about 36 inches, but the range is from 24 to 60 inches.

Soils in the Reesville series are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Birkbeck and very poorly drained Ragsdale soils. The Reesville soils differ from the Fincastle soils in that they have formed entirely in loess.

Reesville silt loam, 0 to 2 percent slopes (ReA).—This soil occupies large areas between the Ragsdale soils in depressions and the Birkbeck soils on slightly higher areas. Many small areas of these nearby soils are included with this soil. Small areas of Fincastle soils, where the underlying glacial till is within 40 inches of the surface, are also included.

This Reesville soil needs artificial drainage if it is cultivated. (Capability unit IIw-2)

Ritchey Series

The Ritchey series consists of shallow, well-drained, light-colored soils. The soils have formed from calcareous glacial till or from outwash overlying limestone. They are gently sloping to moderately steep and occur on uplands and terraces along Twin Creek and in Somers and Gratis Townships. The native vegetation was mixed deciduous hardwoods.

A typical Ritchey soil has a thin silt loam surface layer that is dark grayish brown. The upper part of the subsoil is brown, friable silt loam. Between depths of 10 and 14 inches, the subsoil is dark yellowish-brown clay loam. The lower part of the subsoil has formed in residuum from weathered limestone. It is olive-brown and dark yellowish-brown clay. At a depth of about 17 inches there is limestone bedrock.

The Ritchey soils have low available moisture capacity, a low content of organic matter, and moderately slow permeability.

The Ritchey soils are poorly suited to cultivation because they are shallow.

Technical description of a profile of Ritchey silt loam in Somers Township, SE $\frac{1}{4}$ sec. 34, T. 6 N., R. 2 E.:

- Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth lower boundary.
- B1—6 to 10 inches, brown (10YR 4/3) heavy silt loam; weak, fine, subangular blocky structure; friable; few till pebbles; slightly acid; clear, smooth lower boundary.
- B21t—10 to 14 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, fine, subangular blocky structure; firm; few till pebbles; neutral; clear, smooth lower boundary.
- IIB22t—14 to 17 inches, mixed olive-brown (2.5Y 4/4), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6) clay; very weak, fine, subangular blocky structure; firm; abundant platy limestone fragments; neutral; abrupt, irregular lower boundary.
- R—17 inches +, platy, fractured limestone bedrock.

The thickness of the solum and depth to bedrock range from 10 to 20 inches.

The Ap horizon is brown (10YR 4/3) to dark grayish brown (10YR 4/2), dark brown (10YR 3/3), and brown (10YR 5/3). In some undisturbed areas, the 1- to 4-inch A1 horizon is darker and is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2).

The part of the B horizon developed from glacial drift has a hue of 7.5YR or 10YR, a value of 4 or 5, and a chroma of 3 or 4. The lower part of the B horizon, developed from bedrock, has various colors because of the weathering of impurities in the bedrock. The texture of the B2 horizons is heavy clay loam, heavy silty clay loam, silty clay, and clay.

The B1 horizon is generally slightly acid, but it ranges from slightly acid to medium acid. The lower B2 horizon is normally neutral.

The Ritchey soils are more shallow than the Milton soils, lighter colored than the Channahon soils, and better drained and more shallow than the Millsdale and Randolph soils.

Ritchey and Channahon silt loams, 2 to 6 percent slopes, moderately eroded (RhB2).—This mapping unit contains one or both of these soils in various amounts and patterns. The soils occur above or below rock outcrops. A small acreage is on stream terraces. Here, the soils have developed from silty and loamy outwash over bedrock, and normally have a gravelly clay loam layer just above the bedrock.

Erosion has removed all but 3 or 4 inches of the original surface layer of these soils. Bedrock is at a depth of less

than 20 inches. The available moisture capacity is low to very low. Surface runoff is medium, and susceptibility to further erosion is severe if a vegetative cover is not maintained. Runoff and erosion need to be controlled because loss of additional surface soil would result in a shallower root zone and lower available moisture capacity. (Capability unit IVe-2)

Ritchey and Channahon silt loams, 6 to 12 percent slopes, moderately eroded (RhC2).—This mapping unit contains one or both of these soils in various amounts and patterns. The soils occur at the heads of waterways and along streams. A small acreage is on stream terraces. Here, the soils have developed from silty and loamy outwash over bedrock and generally have a gravelly clay loam layer just above the bedrock.

Erosion has removed all but 3 or 4 inches of the original surface layer of these soils. Bedrock is at a depth of less than 20 inches. The available moisture capacity is very low to low. Surface runoff is rapid, and susceptibility to further erosion is moderate to high if vegetative cover is not maintained. Runoff and erosion need to be controlled because loss of additional surface soil would result in a shallower root zone and lower available moisture capacity. (Capability unit IVe-2)

Ritchey and Channahon silt loams, 12 to 18 percent slopes, moderately eroded (RhD2).—This mapping unit contains one or both of these soils in various amounts and patterns. The soils occur above steep slopes along waterways and also at the heads of waterways. A small acreage is on stream terraces. Here, the soils have developed from silty and loamy outwash over the bedrock, and they typically have a gravelly clay loam layer just above the bedrock.

Erosion has removed all but 3 or 4 inches of the original surface layer of these soils. Bedrock is at a depth of less than 20 inches. The available moisture capacity is very low to low. Surface runoff is very rapid, and susceptibility to further erosion is very high if vegetative cover is not maintained. Runoff and erosion need to be controlled because loss of additional surface soil would result in a shallower root zone and lower available moisture capacity. (Capability unit VIe-1)

Ritchey and Channahon soils, 6 to 12 percent slopes, severely eroded (RnC3).—This mapping unit contains one or both of these soils in various amounts and patterns. The soils occur as strips around the edges of broad hills and along waterways. A small acreage is on stream terraces. Here, the soils have developed from silty and loamy outwash over bedrock and normally have a gravelly clay loam layer just above the bedrock.

The profiles of these soils are shallower than the representative profiles described for the Ritchey and Channahon series. The soil layers are thinner, and there is no layer of till between the subsoil and bedrock. In most places depth to bedrock is less than 12 inches.

Erosion has removed most of the original surface layer, and the present surface layer is clayey. The available moisture capacity is very low. Surface runoff is rapid to very rapid, and susceptibility to further erosion is high. Runoff and erosion need to be controlled, because loss of additional surface soil would result in a shallower root zone and lower available moisture capacity. (Capability unit VIIe-1)

Ritchey and Channahon soils, 12 to 18 percent slopes, severely eroded (RnD3).—This mapping unit contains one or both of these soils in various amounts and patterns. The soils occur above steep slopes along waterways and at the heads of waterways.

The soils have shallower profiles than the representative profiles described for the Ritchey and Channahon series. Soil layers are thinner, and there is no layer of till between the subsoil and bedrock. Depth to bedrock is generally less than 12 inches.

Erosion has removed most of the original surface layer of these soils. The available moisture capacity is very low.

Surface runoff is very rapid, and susceptibility to further erosion is very high. Runoff and erosion need to be controlled, because loss of additional surface soil would result in a shallower root zone and lower available moisture capacity. (Capability unit VIIe-1)

Riverwash

Riverwash (Ro) occurs as islands or as gravel bars and sandbars in or along the large streams. It consists of gravel, flagstones, or cobblestones mixed with some finer textured material.

Most of the areas lies only a few feet above the normal level of streams. A single flood may change the size and shape of an area considerably or may wash it away.

Some areas of Riverwash support a scanty growth of willows and shrubs. The vegetation catches finer textured sediments. This accumulation may raise the elevation of these areas high enough so that they can eventually be cultivated. Most areas of Riverwash are not suited to agriculture, however. Some areas are good sources of sand and gravel. (Capability unit VIIIe-1)

Rodman Series

The Rodman series consists of dark-colored, well-drained, steep and very steep soils. These soils have formed from highly calcareous gravelly glacial drift. They are on terraces, on the sides of outwash valleys, and on kames. The native vegetation was a mixed stand of deciduous hardwoods.

A typical wooded Rodman soil has a very dark brown sandy loam surface layer that is about 16 inches thick. Below this is brown and yellowish-brown, strongly calcareous gravelly sand.

The Rodman soils have very low available moisture capacity and are rapidly permeable. They are poorly suited to agriculture because they are droughty. The underlying sand and gravel is generally suitable for use in construction, however.

Technical description of a profile of a very steep Rodman sandy loam on a wooded slope in Jefferson Township, SE $\frac{1}{4}$, sec. 19, T. 9 N., R. 1 E.:

A11—0 to 6 inches, very dark brown (10YR 2/2) sandy loam; moderate, very fine, granular structure; very friable; roots abundant; many medium-sized pebbles; neutral; lower boundary clear and smooth.

A12—6 to 11 inches, very dark brown (10YR 2/2) sandy loam; weak, very fine, granular structure that breaks to single grain; very friable; roots abundant; many medium-sized and large pebbles; neutral; lower boundary diffuse.

- A13—11 to 16 inches, very dark brown (10YR 2/2) sandy loam; weak, very fine, granular structure that breaks to single grain; very friable; roots abundant; many fine- and medium-sized pebbles and a few large pebbles; calcareous; lower boundary abrupt and smooth.
- C1—16 to 22 inches, mixed brown (10YR 4/3) and yellowish-brown (10YR 5/4) gravelly loamy sand; single grain; a few very large pebbles; strongly calcareous; lower boundary gradual and wavy.
- C2—22 to 60 inches, mixed pale-brown (10YR 6/3), brownish-yellow (10YR 6/6), and light-gray (10YR 7/2) gravelly sand; single grain; a few very large pebbles; strongly calcareous.

Depth to unweathered gravelly sand ranges from about 6 to 18 inches. The texture of the surface layer is variable; sandy loam, gravelly sandy loam, and gravelly loam are predominant. Gravel is common throughout the profile.

Rodman soils occur near areas of Casco and Fox, both of which are thicker and have a subsoil of finer texture than Rodman soils. In Preble County the Rodman soils are mapped only in undifferentiated groups with the Casco and Fox soils.

Ross Series

The Ross series consists of deep, dark-colored, well-drained alluvial soils. These nearly level soils are along most of the streams in the county. They have formed in medium-textured, neutral alluvium washed from upland soils developed in calcareous glacial drift and loess of the Wisconsin age.

The plow layer of a typical Ross soil is very dark grayish-brown, friable loam. The underlying soil material, to a depth of about 46 inches, is a very dark gray and very dark brown, friable loam or clay loam. Below this is dark-brown to dark yellowish-brown, calcareous sandy loam.

The Ross soils have high organic-matter content. They have moderate permeability, a deep root zone, and high available moisture capacity.

Most of the acreage of the Ross soils is farmed. Corn, soybeans, and other crops common to the area grow well. The soils have high natural fertility. Crops respond well to fertilizer. Generally, tilth is good over a wide range of moisture conditions. Flooding is a hazard, however. The frequency of floods varies from stream to stream. Flooding normally occurs once a year during winter or spring. In some areas it is a hazard to winter-grown small grains, such as wheat.

Technical description of a profile of a nearly level Ross loam in a cultivated field in Lanier Township, sec. 36, T. 5 N., R. 3 E.:

- Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; mildly alkaline; lower boundary abrupt and smooth.
- A1—9 to 13 inches, very dark brown (10YR 2/2) loam; weak, fine, granular structure; friable; mildly alkaline; lower boundary clear and smooth.
- C1—13 to 17 inches, very dark gray (10YR 3/1) loam; moderate, very fine and fine, subangular blocky structure; friable; mildly alkaline; lower boundary diffuse.
- C2—17 to 22 inches, very dark gray (10YR 3/1) loam; moderate, very fine and fine, subangular blocky structure; friable; neutral; lower boundary abrupt and smooth.
- C3—22 to 27 inches, black (10YR 2/1) clay loam; moderate, fine and medium, subangular and angular blocky structure; friable; neutral; lower boundary diffuse.
- C4—27 to 33 inches, very dark brown (10YR 2/2) clay loam; moderate, fine and medium, subangular and angular blocky structure; friable; neutral; lower boundary diffuse.

- C5—33 to 39 inches, very dark brown (10YR 2/2) clay loam; moderate, fine and medium, subangular and angular blocky structure; friable; neutral; lower boundary clear and wavy.
- C6—39 to 46 inches, very dark gray (10YR 3/1) and dark yellowish-brown (10YR 3/4) loam; weak, fine and medium, subangular blocky structure; friable; neutral; lower boundary clear and wavy.
- C7—46 to 54 inches, dark-brown (10YR 3/3) sandy loam; massive; friable; mildly alkaline; lower boundary gradual and wavy.
- C8—54 to 72 inches, dark yellowish-brown (10YR 4/4), strongly calcareous, loose sandy loam.

The texture of the surface layer ranges from silt loam to gravelly sandy loam. The color is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2).

In Preble County the Ross soils are typically dark colored at depths of 30 inches or more. The reaction ranges from slightly acid to calcareous in the A horizon and from neutral to calcareous in the C horizon. The texture of the material below a depth of 42 inches ranges from loam to gravelly sandy loam.

The well-drained Ross soils are in the drainage sequence that includes the moderately well drained Medway, somewhat poorly drained Shoals, and very poorly drained Sloan soils.

Ross loam (Rs).—Included with this soil are some areas of Medway soils that are too small to be shown separately on the soil map. Also, a few areas are underlain by bedrock at depths of 35 to 48 inches. (Capability unit IIw-3)

Russell Series

Soils in the Russell series are deep and well drained. They have formed in silt-mantled glacial till of the Wisconsin age. These nearly level to strongly sloping soils are in the uplands. The native vegetation was mixed deciduous hardwoods.

A typical cultivated Russell soil has a plow layer of dark-brown, friable silt loam. The main part of the subsoil is dark yellowish-brown and yellowish-brown silty clay loam; the texture is clay loam in the lower part. At a depth of 50 inches, there is firm, brownish loam till.

Unless severely eroded, the Russell soils have a medium content of organic matter. They have high available moisture capacity and moderately slow permeability.

The Russell soils are suited to the crops commonly grown in the county and are farmed intensively.

Technical description of a profile of Russell silt loam in Heuston Woods 3 miles each of College Corner (Sample PB-8 in laboratory analyses):

- A1—0 to 4 inches, very dark grayish-brown (10YR 3/2); silt loam; moderate, medium and coarse, granular structure; friable when moist, nonsticky and nonplastic when wet; roots common; slightly acid; lower boundary clear.
- A2—4 to 8 inches, dark grayish-brown (10YR 4/2) silt loam with some dark yellowish-brown (10YR 4/4) colors in animal burrow; weak, very fine and fine, subangular blocky structure; friable when moist, slightly sticky and nonplastic when wet; roots common; medium acid; lower boundary gradual.
- A3—8 to 11 inches, dark grayish-brown (10YR 4/2) coarse silty clay loam with some yellowish-brown and dark yellowish-brown (10YR 5/4 and 4/4) colors in animal burrow; weak, fine and medium, subangular blocky structure; friable when moist, slightly sticky and nonplastic when wet; roots few to common; medium acid; lower boundary gradual.
- B1t—11 to 16 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, practically continuous, thin, dark

yellowish-brown (10YR 4/4) clay films on ped surfaces; moderate, fine and medium, subangular blocky structure; moderately firm when moist; roots few to common; medium acid; lower boundary gradual.

- B21t—16 to 21 inches, dark yellowish-brown (10YR 4/4) silty clay loam; interiors of peds yellowish brown (10YR 5/4); thin, dark-brown (10YR 4/3 and 4/2) and dark yellowish-brown (10YR 4/4) clay films nearly continuous on vertical and horizontal ped faces; moderate, fine and medium, subangular blocky structure; firm when moist, moderately sticky and slightly plastic when wet; roots few; strongly acid; lower boundary diffuse.
- B22t—21 to 30 inches, silty clay loam that is yellowish brown (10YR 5/6) in interiors of peds; dark yellowish brown (10YR 4/4 and 5/3) on ped surfaces that occurs as thin, extensive though discontinuous, clay films mostly on the vertical faces; weak to moderate, medium and coarse, subangular blocky structure; firm when moist, slightly plastic and slightly sticky when wet; roots few; strongly acid; lower boundary diffuse.
- B23t—30 to 39 inches, yellowish-brown (10YR 5/4) coarse silty clay loam; thin, dark yellowish-brown (10YR 4/4) clay films and some faint, very dark brown manganese stains; clay films are extensive but discontinuous and occur mainly on the prominent vertical faces; weak to moderate, medium and coarse, subangular blocky structure; firm when moist, slightly sticky and slightly plastic when wet; roots few; strongly acid; some crystalline pebbles; horizon sampled at depths of 30 to 34 inches and 34 to 39 inches; lower boundary gradual.
- IIB3—39 to 50 inches, dark yellowish-brown (10YR 4/4) clay loam; dark-brown (10YR 3/3) stains and clay films; weak, coarse, prismatic structure that breaks to weak subangular blocky; moderately firm when moist, moderately sticky and slightly plastic when wet; roots few; noticeable increased in sand and fine pebbles in this horizon compared with horizons above, and this material appears to have undergone some sorting; horizon has more clay than B23t horizon; some leached limestone fragments in lower part; slightly acid to neutral; lower boundary clear, wavy (as much as 2 inches thick).
- IIC1—50 to 60 inches, light olive-brown (2.5Y 5/4) calcareous loam till faintly mottled with yellowish brown (10YR 5/4) and gray (2.5Y 6/0); weakly effervescent; firm; some leached limestone fragments.
- IIC2—60 to 84 inches, light olive-brown (2.5Y 5/4) and yellowish-brown (10YR 5/4) calcareous loam till; strongly effervescent; very firm.
- IIC3—84 to 104 inches +, intermingled light olive-brown (2.5Y 5/4) and light yellowish-brown (2.5Y 6/4) loam, with considerable silt and some very fine sandy lenses; light yellowish brown (2.5Y 6/4) when dry; appears to be weakly stratified; calcareous; strongly effervescent; moderately firm.

The thickness of the loess mantle is variable over short distances, but it ranges from 18 to 40 inches.

In uncultivated areas there is generally a distinct A2 horizon, 3 to 6 inches thick. In the severely eroded areas, the texture of the surface layer is silty clay loam to loam. The color of the surface layer in cultivated areas is commonly dark brown (10YR 4/3), but the range is from brown (10YR 3/3) to yellowish brown (10YR 5/4).

Depth to calcareous loam till is generally about 40 inches, but the range is from 34 to 53 inches.

Adjacent to the Russell soils are the Miami, Birkbeck, Fincastle, and Xenia soils. The Russell soils are deeper to calcareous till than the Miami soils. They are less deep to till and better drained than the Birkbeck soils. They are similar to, but better drained, than the Fincastle and Xenia soils.

Russell silt loam, 0 to 2 percent slopes (RuA).—This soil occurs in strips on hilltops, along high banks, and on escarpments where lateral movement of ground water is very good. It has a profile similar to that described as representative for the series.

Included with this soil are areas of the moderately well drained Xenia soil that are too small to be shown separately on the soil map.

The surface layer of this Russell soil has a medium content of organic matter. It is generally medium acid. This soil has high available moisture capacity and a deep root zone. Tilth is excellent, and crops respond well to fertilizer and lime. There is little or no hazard of erosion. (Capability unit I-1)

Russell silt loam, 2 to 6 percent slopes (RuB).—This soil occurs on low knolls, on ridgetops, and along gentle slopes that border drainageways. The profile has a thicker surface layer than that described for the series.

Included with this soil are areas of the moderately well drained Xenia soil that are too small to be shown separately on the soil map.

The surface layer of this Russell soil has a medium content of organic matter. It is medium acid. This soil has a deep root zone and high available moisture capacity. Tilth is excellent, and crops respond well to fertilizer and lime. When cultivated, the soil is moderately susceptible to erosion, however. (Capability unit IIe-1)

Russell silt loam, 2 to 6 percent slopes, moderately eroded (RuB2).—This soil is on low knolls, ridgetops, and long, gentle slopes and in areas that border drainageways. Part of the original plow layer has been removed by erosion, and the present plow layer is a mixture of subsoil and surface soil. This has little effect on tilth, but it reduces the organic-matter content and available moisture capacity.

Included with this soil are areas of moderately well drained Xenia and well drained Wynn soils that are too small to be shown separately on the soil map.

This Russell soil has a moderately deep root zone. The surface layer is medium acid. Crops respond well to lime and fertilizer. Erosion is a hazard when this soil is cultivated, however. (Capability unit IIe-1)

Russell silt loam, 6 to 12 percent slopes, moderately eroded (RuC2).—This soil occurs on hillsides, on high knolls, and along waterways. The present plow layer is a mixture of about equal parts of the subsoil and the original surface soil. Otherwise, the profile is similar to that described for the series.

Included with this soil are a few areas of well-drained Wynn soils.

This Russell soil has a moderately deep root zone. The available moisture capacity is high, and the organic-matter content is medium to low. The surface layer is medium acid to slightly acid. Erosion is a continuing hazard when this soil is cultivated. (Capability unit IIIe-1)

Russell silt loam, 12 to 18 percent slopes, moderately eroded (RuD2).—This soil occurs on hillsides and along waterways. The present plow layer is a mixture of about equal parts of the subsoil and the original surface soil.

This soil has a moderately deep root zone. The available moisture capacity is high, and the organic-matter content is medium to low. The surface layer is medium acid to slightly acid. When cultivated, this soil is subject to severe erosion. (Capability unit IVe-1)

Russell soils, 6 to 12 percent slopes, severely eroded (RvC3).—These soils are on hillsides, on high knolls, and along waterways. They are similar to Russell silt loam, 6

to 12 percent slopes, moderately eroded, but erosion has removed the original surface layer and the present plow layer now consists mostly of subsoil.

The organic-matter content is low, and the root zone is moderately deep. Crops respond well to lime and fertilizer. These soils are not well suited to cultivated crops, however, because of the effects of erosion and the severe hazard of additional erosion. (Capability unit IVE-2)

Russell soils, 12 to 18 percent slopes, severely eroded (RvD3).—These soils are on hillsides and along natural waterways. They are severely eroded as a result of an inadequate cover of vegetation and runoff from nearby areas. The plow layer consists mainly of subsoil, but in some places part of the original surface layer remains.

These soils have a moderately deep root zone. The surface layer has a low content of organic matter. Plants respond well to lime and fertilizer. The soils are poorly suited to cultivated crops, however, because of strong slopes and the hazard of additional erosion. (Capability unit VIe-1)

Shoals Series

The Shoals series consists of deep, nearly level, somewhat poorly drained soils that are light colored. These soils lie on flood plains and have formed in alluvium washed from soils that are on adjacent uplands and that have developed in calcareous till and loess of the Wisconsin age. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Shoals soil has a dark grayish-brown surface layer that is silt loam in the upper part and loam in the lower part. Below this is dark grayish-brown silt loam that has little or no structure. At a depth of 45 inches, there is loose sand and gravel.

The Shoals soils are neutral or slightly calcareous in the upper part of the profile. They have high available moisture capacity and are moderately slowly permeable above the sand and gravel substratum.

Technical description of a profile of a nearly level Shoals silt loam on a flood plain in Dixon Township, SW $\frac{1}{4}$ sec. 35, T. 7 N., R. 1 E.:

- A11—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine and very fine, granular structure; friable; slightly calcareous; lower boundary clear and smooth.
- A12—3 to 9 inches, dark grayish-brown (10YR 4/2) loam; many dark reddish-brown (5YR 3/4) stains along root channels; weak, fine, granular structure; friable; slightly calcareous; lower boundary clear and smooth.
- C1—9 to 14 inches, dark grayish-brown (10YR 4/2) silt loam; friable; massive; slightly calcareous; lower boundary clear and smooth.
- C2—14 to 26 inches, gray (10YR 5/1) loam; common, medium, prominent, dark-brown (7.5YR 4/4) mottles; few, fine, prominent, reddish-brown (5YR 4/4) mottles; common, medium, faint, yellowish-brown (10YR 5/6) mottles; friable; massive; slightly calcareous; lower boundary abrupt and smooth.
- C3—26 to 45 inches, grayish-brown (10YR 5/2) loam; many, coarse, faint, yellowish-brown (10YR 5/4) mottles and common, fine, distinct, yellowish-red (5YR 4/6) mottles; very friable; massive; strongly calcareous; lower boundary clear and wavy.
- C4—45 inches +, sand and gravel; loose; single grain.

The color of the A horizon ranges from dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2) or brown

(10YR 5/3). In many places fine-textured layers of alluvium occur below the plow layer. The material below a depth of 40 inches ranges from loamy sand and gravel to calcareous loam and clay loam till.

The profile down to a depth of 26 inches is neutral, mildly alkaline, or slightly calcareous, and at 45 inches, strongly calcareous.

The Shoals soils are in a drainage sequence with the well drained Ross, moderately well drained Medway, and very poorly drained Sloan soils.

Shoals silt loam (Sh).—This soil occurs in small stream valleys and in slight depressions on the flood plains of the large streams. Where flood-control measures have not been applied, this soil is flooded about once a year, normally in winter or spring.

Included with this soil are some areas of very poorly drained Sloan soils that are too small to be shown separately on the soil map. Also, a few areas are underlain by bedrock at depths of 35 to 48 inches.

This Shoals soil has a deep root zone and high available moisture capacity. It has a seasonal high water table. Surface runoff is very slow. Crops respond well to fertilizer. (Capability unit IIw-1)

Sleeth Series

The Sleeth series consists of deep, somewhat poorly drained soils. These soils have formed on terraces in outwash material that in places is capped with either silty loess or outwash. The terraces are high enough that the soils are rarely flooded.

A typical cultivated Sleeth soil has a dark-brown silt loam surface layer that is friable. The upper part of the subsoil has several layers of dark grayish-brown and dark yellowish-brown sandy clay loam or clay loam. Dark grayish-brown sand and gravel are below a depth of 50 inches.

The Sleeth soils are moderately slowly permeable above the underlying sand and gravel. They have medium organic-matter content and moderate to high available moisture capacity.

When the seasonal high water table is adequately lowered, the Sleeth soils can be cultivated.

Technical description of a profile of Sleeth silt loam in a cultivated field in Jackson Township, SE $\frac{1}{4}$ sec. 21, T. 8 N., R. 1 E.:

- Ap—0 to 7 inches, dark-brown (10YR 3/3) silt loam; somewhat massive, but breaks to weak, fine, subangular blocky structure; friable; medium acid; lower boundary abrupt and smooth.
- A3—7 to 12 inches, dark-brown (10YR 3/3) silt loam; few, fine, distinct, yellowish-brown (10YR 5/6) and common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure; friable; medium acid; lower boundary abrupt and smooth.
- B21tg—12 to 17 inches, dark yellowish-brown (10YR 4/4) silty clay loam; discontinuous, dark grayish-brown (2.5Y 4/2) clay coatings on ped surfaces; common, fine, faint, yellowish-brown (10YR 5/4) mottles; strong, medium, subangular blocky structure; firm; slightly acid; lower boundary diffuse.
- IIB22tg—17 to 21 inches, dark yellowish-brown (10YR 4/4) clay loam; dark grayish-brown (2.5Y 4/2) clay coatings on ped surfaces; many, fine and medium, distinct, yellowish-brown (10YR 5/6) and few, fine, distinct, grayish-brown (10YR 5/2) mottles; strong, coarse, subangular blocky structure; firm; neutral; lower boundary clear and smooth.

- IIB23g—21 to 26 inches, dark grayish-brown (10YR 4/2) sandy clay loam; many, fine, distinct, yellowish-brown (10YR 5/6) and common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; neutral; lower boundary diffuse.
- IIB24g—26 to 32 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; many, medium, distinct, dark grayish-brown (10YR 4/2) and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, (2.5Y 4/2) filling in old crawfish hole; moderate, medium and coarse, subangular blocky structure; friable; neutral; lower boundary clear and smooth.
- IIB31—32 to 37 inches, dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/6), and dark grayish-brown (2.5Y 4/2) clay loam; a very dark gray (10YR 3/1) pocket of silt loam; somewhat massive, but breaks to weak, medium, subangular blocky structure; friable; slightly calcareous; lower boundary diffuse.
- IIB32—37 to 41 inches, dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/6), and dark grayish-brown (2.5Y 4/2) loam; many limestone fragments; massive; friable; slightly calcareous; lower boundary clear and wavy.
- IIB33—41 to 50 inches, dark grayish-brown (10YR 4/2), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/6) loam; single grain; calcareous; lower boundary diffuse.
- IIC—50 to 60 inches, dark grayish-brown (10YR 4/2) sand and gravel; single grain; calcareous.

The color of the Ap horizon ranges from dark brown (10YR 3/3) to dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2). The texture of the surface layer is commonly silt loam.

The texture of the B2 horizons is gravelly clay loam, sandy clay loam, silty clay loam, clay loam, or clay. The material underlying these soils ranges from stratified sand and gravel to stratified sand and gravel interspersed with lenses of sandy loam and loam.

The Sleeth soils are similar to the nearby dark-colored Crane soils, except for differences in color.

Sleeth silt loam, 0 to 2 percent slopes (S1A).—This soil occurs on stream terraces near the breaks to the uplands and on outwash plains.

Included with this soil are areas that are underlain by sandy loam or loam instead of sand and gravel.

This Sleeth soil has a deep root zone and fair tilth. Crops respond well to fertilizer and lime. Surface runoff is slow, and susceptibility to erosion is slight. Drainage is necessary to lower the seasonal high water table, however. (Capability unit IIw-2)

Sloan Series

The Sloan series consists of deep, very poorly drained soils that are dark colored. These soils have formed in neutral to slightly alkaline alluvium that has washed from higher areas and settled on flood plains. The native vegetation was a mixed stand of deciduous hardwoods.

A typical cultivated Sloan soil has a very dark brown silt loam surface layer that is friable. Below a depth of 12 inches and extending to about 38 inches, there is dark-gray clay loam mottled with yellowish brown, dark reddish brown, and yellowish red. Below a depth of 38 inches, there are layers of silty clay loam, loam, and gravelly loam that extend below 70 inches.

The Sloan soils have a high content of organic matter and high available moisture capacity. They are moderately slowly permeable to water and air.

Technical description of a profile of Sloan silt loam in a cultivated field in Israel Township, NE $\frac{1}{4}$ sec. 17, T. 6 N., R. 1 E.:

- Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; weak, fine, crumb structure that grades to weak, medium, subangular blocky with increasing depth; friable; pH 7.0; lower boundary abrupt and smooth.
- A1—8 to 12 inches, very dark brown (10YR 2/2) loam; moderate, medium, subangular blocky structure; friable; neutral; lower boundary clear and smooth.
- C1g—12 to 18 inches, dark-gray (10YR 4/1) clay loam; few, fine, prominent, dark reddish-brown (5YR 3/4) and few, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; friable; neutral; lower boundary diffuse.
- C2g—18 to 23 inches, dark-gray (10YR 4/1) clay loam; common, fine, prominent, yellowish-red (5YR 4/6) and many, medium, prominent, dark reddish-brown (5YR 3/4) mottles; moderate, medium, subangular blocky structure; friable; neutral; lower boundary gradual and wavy.
- C3g—23 to 30 inches, dark-gray (10YR 4/1) clay loam; many, fine, prominent, dark reddish-brown (5YR 3/4) mottles; common, fine, faint, yellowish-brown (10YR 5/6) mottles; common, medium, prominent, yellowish-red (5YR 4/6) mottles; moderate, coarse, subangular blocky structure; firm; a few manganese concretions and stains; slightly alkaline; lower boundary diffuse.
- C4g—30 to 38 inches, gray (10YR 5/1) clay loam; many, fine, prominent, dark reddish-brown (5YR 3/4) mottles; many, medium, prominent, yellowish-red (5YR 4/6) mottles; common, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; a few manganese stains and concretions; slightly alkaline; lower boundary gradual and wavy.
- C5g—38 to 46 inches, mixed gray (10YR 5/1), yellowish-brown (10YR 5/6), and yellowish-red (5YR 4/6) silty clay loam; massive; friable; slightly calcareous; lower boundary clear and wavy.
- IIC6g—46 to 57 inches, mixed gray (10YR 5/1) and yellowish-brown (10YR 5/6 and 5/8) loam; massive; friable; some gravel; strongly calcareous.
- IIC7—57 to 64 inches, gray (10YR 5/1) gravelly loam; massive; friable; strongly calcareous; water entered the pit in this horizon.
- IIC8—64 to 74 inches, dark yellowish-brown (10YR 4/4) loam, with pockets of dark gray (N 4/0); massive; friable; strongly calcareous.

The total thickness of the A horizons is variable; it ranges from 10 to 24 inches. Beneath the A horizon the texture to a depth of about 40 inches ranges from loam and silt loam to clay loam and silty clay loam. The underlying materials are loamy sand and gravel, calcareous loam, clay loam till, or loam and silt loam alluvium.

The Sloan soils are adjacent to the well drained Ross soils, moderately well drained Medway soils, and somewhat poorly drained Shoals soils.

Sloan silt loam (So).—This soil occurs in small stream valleys and in depressions on the flood plains of large streams. It generally is flooded once a year during winter or in spring.

Included with this soil are some areas of Medway and Shoals soils that are too small to be shown separately on the soil map. Also included are areas that have a lighter colored surface layer as a result of recent deposits of alluvium. A few areas are underlain by bedrock at depths of 35 to 48 inches.

Sloan silt loam has very slow surface runoff. It has a deep root zone when the seasonal high water table is lowered by drainage. Flooding and wetness are continuing limitation to the use of this soil, however. (Capability unit IIIw-2)

Thackery Series

Soils in the Thackery series are deep, moderately well drained, and nearly level to gently sloping. They have formed on outwash terraces that are mantled with silt. These terraces are above the level normally reached by stream flooding. The native vegetation was a mixed stand of deciduous hardwoods.

A typical cultivated Thackery soil has a very dark grayish-brown silt loam surface layer and a dark-brown silt loam subsurface layer, both within a depth of 13 inches. Most of the subsoil layers are dark yellowish-brown silty clay loam and sandy clay loam. The lower layers, between depths of 26 and 43 inches, are mottled. Below a depth of 43 inches, there are layers of brown and grayish-brown loam and sandy loam outwash material.

The Thackery soils have medium organic-matter content, moderate permeability, and moderate to high available moisture capacity.

The Thackery soils normally have an adequate root zone and are easy to till. They are well suited to most crops commonly grown in the county.

Technical description of a profile of Thackery silt loam in a formerly cultivated field in Jackson Township, SE $\frac{1}{4}$ sec. 29, T. 8 N., R. 1 E.:

- Ap—0 to 8 inches, very dark grayish-brown (10YR 3.5/2) silt loam; grayish brown (10YR 5/2) when dry; weak, fine, subangular blocky structure; friable; medium acid; lower boundary abrupt and smooth.
- A2—8 to 13 inches, dark-brown (10YR 3/3) silt loam; light brownish gray (10YR 6/2) when dry; weak, medium, platy structure that breaks to weak, fine, granular; friable; medium acid; lower boundary clear and smooth.
- B1—13 to 17 inches, brown (10YR 4/3) silt loam; brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable; medium acid; lower boundary clear and smooth.
- B21t—17 to 21 inches, dark yellowish-brown (10YR 4/4) silty clay loam; thin, discontinuous, dark yellowish-brown (10YR 3/4) clay films on ped surfaces and few, fine, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; strong, medium, angular blocky structure; firm; medium acid; lower boundary diffuse.
- B22t—21 to 26 inches, dark yellowish-brown (10YR 4/4) silty clay loam; thin, discontinuous, dark yellowish-brown (10YR 3/4) clay films on ped surfaces and few, medium, distinct, yellowish-brown (10YR 5/4, 5/6, and 5/8) mottles; strong, medium and coarse, subangular blocky structure; firm; medium acid; lower boundary clear and wavy.
- B23t—26 to 31 inches, dark yellowish-brown (10YR 4/4) clay loam; thin, discontinuous, dark yellowish-brown (10YR 3/4) clay films on ped surfaces and few, medium, distinct, brown (10YR 4/3) and yellowish-brown (10YR 5/4, 5/6, and 5/8) mottles; moderate, coarse, subangular blocky structure; firm; slightly acid; few manganese concretions; lower boundary diffuse.
- B24t—31 to 35 inches, mixed yellowish-brown (10YR 5/4, 5/6, and 5/8) sandy clay loam; thin, discontinuous, dark yellowish-brown (10YR 3/4) clay films on ped surfaces and few, medium, distinct, light yellowish-brown (10YR 6/4) mottles; weak, coarse, subangular blocky structure; friable; medium acid; lower boundary abrupt and smooth.
- B31—35 to 43 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles and a few dark yellowish-brown (10YR 3/4) clay flows on ped surfaces; massive; friable; neutral; lower boundary abrupt and wavy.
- IIC1—43 to 48 inches, brown (10YR 5/3) sandy loam; massive; slightly calcareous; friable.

IIC2—48 to 53 inches, grayish-brown (10YR 5/2) loam; massive; friable; slightly calcareous.

IIC3—53 to 65 inches, brown (10YR 4/3) sandy loam; yellowish-brown (10YR 5/6 and 5/8) pockets and gray (10YR 5/1) streaks; friable; strongly calcareous.

IIC4—65 to 73 inches, brown (10YR 4/3) loam; yellowish-brown (10YR 5/6) pockets and gray (10YR 5/1) streaks; friable; strongly calcareous.

IIC5—73 to 78 inches, brown (10YR 4/3) sandy loam; friable; strongly calcareous.

The silt mantle is as much as 30 inches thick. It is thickest in areas adjacent to soils of the Russell drainage sequence and thinnest in areas adjacent to soils of the Miami drainage sequence.

The color of the surface layer ranges from brown (10YR 4/3) to very dark grayish brown (10YR 3.5/2).

The color of the matrix of the B2 horizon ranges from brown (10YR 5/3) through yellowish brown (10YR 5/6) to dark yellowish brown (10YR 3/4). The texture of the lower B2 horizon ranges from sandy clay loam to gravelly clay loam and clay loam.

The texture of the substratum ranges from gravelly or sandy loam to stratified sand and gravel.

The Thackery soils are generally next to the well drained Wea and Ockley, the moderately well drained Tippecanoe, the somewhat poorly drained Sleeth, and the very poorly drained Westland soils.

Thackery silt loam, 0 to 2 percent slopes (ThA).—This soil is on broad outwash plains and on second bottoms near the breaks to the uplands.

Included with this soil are some areas of the somewhat poorly drained Sleeth soils that are too small to be shown separately on the soil map.

Surface runoff is slow to medium, and the hazard of erosion is slight when this Thackery soil is cultivated. (Capability unit I-1)

Thackery silt loam, 2 to 6 percent slopes (ThB).—This soil occurs on broad outwash plains and on second bottoms near the breaks to the uplands.

Included with this soil are some areas of the somewhat poorly drained Sleeth and well-drained Ockley soils that are too small to be shown separately on the soil map.

Surface runoff is medium, and susceptibility to erosion is moderate when this Thackery soil is cultivated. (Capability unit IIe-1)

Tippecanoe Series

This series consists of deep, moderately well drained, nearly level to gently sloping soils that are dark colored. These soils have formed in outwash materials that are mantled with silt. They are on terraces that are generally above flood level. The native vegetation was a mixed stand of deciduous hardwoods.

A typical Tippecanoe soil has a dark layer of silty clay loam to a depth of about 18 inches. The subsoil is brownish clay loam to a depth of about 37 inches. There is a brown transitional layer to poorly sorted sandy material at a depth of about 42 inches.

The Tippecanoe soils have high organic-matter content, high available moisture capacity, and moderate permeability. They have a deep root zone and are easy to till. They are well suited to crops commonly grown in the county.

Technical description of a profile of Tippecanoe silt loam located 7 miles west and 4 miles north of Eaton in Jackson Township (PB-37 in laboratory analyses):

- Ap—0 to 6 inches, very dark brown (10YR 2/2) fine silt loam; moderate, fine and medium, subangular blocky structure; friable; slightly acid; lower boundary smooth and abrupt.
- A12—6 to 8 inches, very dark brown (10YR 2/2) silty clay loam; moderate, medium, angular blocky structure; friable; lower boundary smooth and abrupt.
- A13—8 to 13 inches, black (10YR 2/1) silty clay loam; strong, very fine and fine, angular and subangular blocky structure; friable; neutral; lower boundary diffuse.
- A14—13 to 18 inches, black (10YR 2/1) silty clay loam; strong, very fine and fine, angular and subangular blocky structure; friable; neutral; lower boundary smooth and clear.
- B1t—18 to 22 inches, brown (10YR 4/3) clay loam; thick, continuous, black (10YR 2/1) clay films on ped surfaces; strong, fine and medium, angular blocky structure; friable; neutral; lower boundary clear and smooth.
- B21t—22 to 30 inches, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) fine clay loam; medium, continuous, very dark brown (10YR 2/2) clay films on ped surfaces; moderate, medium, subangular blocky structure; firm; neutral; boundary diffuse.
- B22t—30 to 37 inches, yellowish-brown (10YR 5/4) clay loam; thin, discontinuous, very dark grayish-brown (10YR 3/2) clay films on ped surfaces and a few very dark grayish-brown (10YR 3/2) root fillings; weak, medium, subangular blocky structure; firm; neutral; lower boundary smooth and clear.
- IIB3t—37 to 42 inches, brown (10YR 4/3) and yellowish-brown (10YR 5/4) sandy clay loam; thin, discontinuous, very dark grayish-brown (10YR 3/2) clay coatings on ped surfaces and few very dark grayish-brown (10YR 3/2) root channel fillings; weak, medium, subangular blocky structure; friable; neutral; lower boundary abrupt and wavy.
- IIC1—42 to 50 inches, yellowish-brown (10YR 5/4) loamy sand; single grain; very friable; less than 1 percent of horizon consists of coarse material; slightly calcareous.
- IIC2—50 to 60 inches, sand; less than 1 percent of horizon consists of coarse material; strongly calcareous.
- IIC3—60 to 65 inches, loamy sand; less than 1 percent of horizon consists of coarse material; strongly calcareous.

The silt mantle is as much as 36 inches thick. The A horizon ranges from strongly acid to neutral. The reaction increases down through the profile. The IIB3t or IIC1 horizon is calcareous. Depth to calcareous sand and gravel ranges from 42 to 66 inches.

These soils occur next to the well-drained Wea and somewhat poorly drained Crane soils and the light-colored Ockley, Thackery, and Sleeth soils.

Tippecanoe silt loam, 0 to 2 percent slopes (TpA).—

Included with this soil are some spots of somewhat poorly drained Crane soils that are too small to be shown separately on the soil map. Also included are some areas that are underlain by loamy outwash instead of sand and gravel. Most of these areas are near the breaks to the uplands.

This Tippecanoe soil has slow to medium surface runoff, and there is little or no hazard of erosion. (Capability unit I-1)

Tippecanoe silt loam, 2 to 6 percent slopes (TpB).—

This soil occurs on broad outwash plains and on outwash stream terraces near the breaks to the uplands.

Included with this soil are some areas of the well-drained Wea soils that are too small to be shown separately on the soil map. Also included are a few nearly level areas. In addition there are areas that are underlain by sandy loam or loam instead of sand and gravel. Most of these areas occur where this terrace soil grades to the uplands.

This Tippecanoe soil has medium surface runoff and moderate susceptibility to erosion. The included nearly level areas have only slight susceptibility to erosion, however. (Capability unit IIE-1)

Warsaw Series

The Warsaw series contains well-drained, dark-colored soils that are mostly moderately deep to sand and gravel. These soils have formed in silty and loamy material on outwash terraces, most of which are high enough that they rarely, if ever, are flooded. The native vegetation was mixed prairie grasses and scattered deciduous hardwoods.

A typical Warsaw soil has a very dark brown silt loam surface layer about 13 inches thick. This is underlain by a very dark brown clay loam subsoil that extends to a depth of about 27 inches. Between 27 and 35 inches, the subsoil is very dark grayish-brown and dark-brown clay. Layers of sandy loam and loamy sand underlie the clay, and these, in turn, are underlain by gravelly sand at a depth of 53 inches.

The Warsaw soils have high organic-matter content and moderate available moisture capacity. They are moderately permeable above the sandy and gravelly substratum.

The Warsaw soils are well suited to crops commonly grown in the county, but in dry periods they are more droughty than soils not underlain by sand and gravel.

Technical description of a profile of a nearly level Warsaw silt loam in a cultivated field in Jefferson Township, NW $\frac{1}{4}$ sec. 4, T. 9 N., R. 1 E.:

- Ap—0 to 7 inches, very dark brown (10YR 2/2) silt loam; very dark grayish brown (10YR 3/2) when crushed; weak, fine, granular structure; friable; roots abundant; mildly alkaline; lower boundary clear and smooth.
- A1—7 to 9 inches, very dark brown (10YR 2/2) loam; very dark grayish brown (10YR 3/2) when crushed; weak, fine, granular structure; friable; roots abundant; mildly alkaline; lower boundary abrupt and smooth.
- A3—9 to 13 inches, very dark brown (10YR 2/2) silt loam; very dark grayish brown (10YR 3/2) when crushed; moderate, fine and medium, subangular blocky structure; friable; roots plentiful; mildly alkaline; lower boundary abrupt and smooth.
- B21t—13 to 17 inches, very dark brown (10YR 2/2) clay loam; dark yellowish brown (10YR 3/4) when crushed; strong, fine, angular blocky structure; friable; neutral; roots plentiful; lower boundary diffuse.
- B22t—17 to 22 inches, very dark brown (10YR 2/2) clay loam; dark brown (10YR 3/3) when crushed; strong, fine, angular blocky structure; roots plentiful; amount of gravel increases with depth; neutral; lower boundary abrupt and smooth.
- B23t—22 to 27 inches, very dark brown (10YR 2/2) clay loam; dark brown (10YR 3/3) when crushed; moderate, medium, subangular blocky structure; firm; thin, continuous clay coatings on ped surfaces; few roots; few pebbles; neutral; lower boundary abrupt and smooth.
- B24t—27 to 30 inches, mixed very dark grayish-brown (10YR 3/2) and dark-brown (10YR 3/3) clay; shiny, discontinuous, very dark grayish-brown (10YR 3/2) clay coatings on ped surfaces; moderate, medium, subangular blocky structure; firm; plastic and waxy; a few large and many very small pebbles throughout horizon; few roots; neutral; lower boundary clear and smooth.
- B25t—30 to 35 inches, mixed very dark grayish-brown (10YR 3/2), dark-brown (10YR 3/3), and brown (10YR 4/3) clay; fairly thick, shiny, discontinuous, very dark grayish-brown (10YR 3/2) clay coatings on ped surfaces; weak, coarse, subangular blocky structure;

firm; plastic and waxy; few roots; a few large and many very small pebbles throughout horizon; neutral; lower boundary abrupt and wavy.

IIC1—35 to 42 inches, brown (10YR 4/3) sandy loam; very dark grayish-brown (10YR 3/2) clay tongues that extend from B25t horizon; massive but breaks to weak subangular blocky structure along clay tongues; friable; many limestone fragments; slightly calcareous; lower boundary clear and wavy.

IIC2—42 to 53 inches, dark grayish-brown (10YR 4/2) gravelly loamy sand; single grain; calcareous.

IIC3—53 to 60 inches, dark grayish-brown (10YR 4/2) gravelly sand that consists of coarse- and medium-sized grains of sand and fine- and medium-sized pebbles; single grain; strongly calcareous.

In Preble County the Warsaw soils are generally neutral in reaction throughout the profile. The texture of the B horizons ranges from silty clay loam and clay loam in the upper part to clay loam, sandy clay loam, and clay in the lower part. The content of gravel in the B horizon is variable and normally increases with depth.

The Warsaw soils are shallower to sand and gravel than the adjacent Wea soils. They are better drained than the adjacent Tippecanoe and Westland soils. They are similar to Fox soils but are dark colored.

Warsaw silt loam, 0 to 2 percent slopes (WcA).—This soil occurs on outwash stream terraces and on broad outwash plains.

Included with this soil are some areas of the well-drained Wea soils that are too small to be shown separately on the soil map. Also included are areas that are underlain by loam and sandy loam instead of sand and gravel. Most of these areas occur where this terrace soil grades to the uplands.

This Warsaw soil has a moderately deep root zone, and tilth is good. Surface runoff is very slow, and the hazard of erosion is slight. (Capability unit IIs-1)

Wea Series

The Wea series consists of deep, well-drained, nearly level and gently sloping soils that are dark colored. These soils have formed in silty or loamy outwash material. In some places the outwash is mantled with up to 3 feet of wind-deposited silty material. These soils are on terraces and outwash plains and are high enough above the adjacent flood plains that they seldom are flooded. The native vegetation was mixed prairie grasses and scattered deciduous hardwoods.

A typical Wea soil has a surface layer of about 14 inches of very dark brown silt loam. This is underlain by about 13 inches of very dark brown and dark reddish-brown clay loam. Dark reddish-brown clay occurs between depths of 27 and 33 inches. With increasing depth, the soil grades from dark reddish-brown to brown sandy loam and sandy clay loam. Below a depth of 52 inches, there is brown or yellowish-brown loamy outwash material.

The Wea soils have high organic-matter content, high available moisture capacity, and moderate permeability. They are well suited to the crops commonly grown in the county.

Technical description of a profile of a nearly level Wea silt loam in a meadow in Twin Township, NW $\frac{1}{4}$ sec. 27, T. 6 N., R. 3 E.:

Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; dark brown (10YR 3/3) when crushed; weak, fine and medium, subangular blocky structure that breaks to

moderate, medium, granular; friable; neutral; roots abundant; lower boundary diffuse and smooth.

A1—8 to 14 inches, very dark brown (10YR 2/2) fine silt loam; dark brown (10YR 3/3) when crushed; weak, medium, subangular blocky structure; friable; plentiful roots and many worm casts; neutral; lower boundary diffuse and smooth.

B11—14 to 18 inches, very dark brown (10YR 2/2) clay loam; dark brown (10YR 3/3) when crushed; very weak, fine, prismatic structure that breaks to moderate, fine and medium, subangular blocky; friable; few roots and many worm casts; neutral; lower boundary diffuse and smooth.

B12—18 to 23 inches, very dark brown (10YR 2/2) clay loam; dark brown (10YR 3/3) when crushed; moderate, fine and medium, subangular blocky structure; friable; few roots and many worm casts; neutral; lower boundary abrupt and smooth.

B21t—23 to 27 inches, dark reddish-brown (5YR 3/4) clay loam; thin, discontinuous, very dark brown (10YR 2/2) coatings on ped surfaces; moderate, coarse, subangular blocky structure; firm; few roots and worm casts; contains more medium-sized pebbles than horizons above; neutral; lower boundary diffuse and smooth.

B22t—27 to 33 inches, dark reddish-brown (5YR 3/3) clay; thin, discontinuous, very dark brown (10YR 2/2) coatings on ped surfaces and few very dark brown (10YR 2/2) worm casts; weak, coarse, subangular blocky structure; firm; few roots; few medium-sized and few coarse-sized pebbles; neutral; lower boundary diffuse and wavy.

B23t—33 to 39 inches, dark reddish-brown (5YR 3/4) and dark-brown (7.5YR 3/2) sandy clay loam; thin, discontinuous, dark-brown (10YR 3/3) coatings on ped surfaces and dark-brown (10YR 3/3) worm casts and root channels; weak, coarse, subangular blocky structure; firm; few roots; neutral; lower boundary clear and smooth.

B24t—39 to 47 inches, brown (10YR 4/3) sandy loam; clay tongues that extend from horizon above; worm casts of very dark grayish brown (10YR 3/2); massive in place but breaks along weak faces; friable; few roots; neutral; lower boundary abrupt and smooth.

B3—47 to 52 inches, dark-brown (7.5YR 3/2) sandy clay loam; clay tongues extend from horizon above; worm casts of very dark gray (10YR 3/1); structureless; friable; few roots; neutral; lower boundary abrupt and wavy.

IIC1—52 to 55 inches, loam that is brown (10YR 5/3) when crushed; very dark grayish-brown (10YR 3/2) clay tongues; massive; friable; few roots; horizon consists predominantly of limestone fragments; slightly calcareous; lower boundary abrupt and wavy.

IIC2—55 to 65 inches, yellowish-brown (10YR 5/4) loam; massive; friable; strongly calcareous.

IIC3—65 to 72 inches, brown (10YR 5/3) loam; massive; friable; strongly calcareous.

In Preble County the material underlying the Wea soils is variable. Close to the upland-terrace border, the underlying material is loam that has been only slightly water worked. As the distance from the border increases, the purity of the underlying material also increases. The loam grades to loamy sand and gravel that, in turn, grades to clean stratified sand and gravel.

Depth to calcareous material is commonly about 48 inches, but the range is 42 to 65 inches.

The Wea soils are deeper to sand and gravel than the Warsaw soils. They are similar to the Ockley soils but are darker colored.

Wea silt loam, 0 to 2 percent slopes (WeA).—This soil occurs on the stream terraces midway between the uplands and the break between the first bottoms and terraces. It is also in small outwash valleys.

Included with this soil are small areas of Warsaw and Tippecanoe soils that are too small to be shown separately

on the soil map. Also included are areas that are underlain by loam and sandy loam instead of sand and gravel. Most of these areas are near where the soil grades to the uplands.

This Wea soil has good tilth over a wide range of soil moisture conditions. Surface runoff is very slow, and susceptibility to erosion is slight. (Capability unit I-1)

Westland Series

The Westland series consists of dark-colored soils that are very poorly drained. These soils have formed in silty and loamy outwash material that overlies calcareous sand and gravel. They occupy depressions and nearly level areas. Most areas of Westland soils are not subject to flooding, but a few areas along intermittent streams are flooded by rapid runoff. The native vegetation was a mixed stand of deciduous hardwoods.

Typically, a Westland soil has a very dark brown silt loam surface layer that grades to very dark gray at a depth of about 8 inches. The upper part of the subsoil is mottled dark-gray clay loam; the subsoil is yellowish brown at about 26 inches. Below a depth of 31 inches there is a mottled gray gravelly loam that extends to about 44 inches. This is underlain by gray and yellowish-brown gravelly sand loam and gravelly sand.

The Westland soils have high organic-matter content, high available moisture capacity, and moderately slow permeability. They have a seasonal high water table and are subject to surface runoff from higher areas. If cultivated, they need artificial drainage.

Technical description of a profile of Westland silt loam in Gratis Township, SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 4 N., R. 3 E.:

- Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; fine subangular blocky structure; friable; slightly acid; abrupt, smooth lower boundary.
- A3—8 to 12 inches, very dark gray (10YR 3/1) silt loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; friable; slightly acid; clear, smooth lower boundary.
- B1tg—12 to 17 inches, dark-gray (10YR 4/1) clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; thin, intermittent clay films on ped surfaces; moderate, medium, subangular blocky structure; friable; neutral; clear, smooth lower boundary.
- B21tg—17 to 26 inches, dark-gray (10YR 4/1) fine clay loam; many, medium, distinct gray (10YR 5/1) and yellowish-brown (10YR 5/6) mottles; medium continuous clay films on ped surfaces; moderate medium subangular blocky structure; firm; neutral; clear, smooth lower boundary.
- B22tg—26 to 31 inches, yellowish-brown (10YR 5/6) clay loam; many, medium, distinct, gray (10YR 5/1) mottles and coatings; medium, continuous clay films on vertical ped surfaces and intermittent clay films on horizontal surfaces; weak, medium, angular blocky structure; firm; a few small pebbles; neutral; clear, smooth lower boundary.
- IIB31g—31 to 38 inches, gray (10YR 5/1) gravelly loam; many, medium and coarse, prominent, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/8) mottles; intermittent, thin, gray clay coatings on vertical ped surfaces; weak, fine and medium, subangular blocky structure; friable; moderately calcareous; diffuse, smooth lower boundary.
- IIB32g—38 to 44 inches, gray (10YR 5/1) gravelly loam; many, medium, prominent, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; calcareous; abrupt, irregular lower boundary.
- IIC1—44 to 50 inches, gray (10YR 5/1) and yellowish-brown (10YR 5/4) gravelly sandy loam; many, medium and

coarse, distinct mottles; massive; friable; strongly calcareous.

IIC2—50 to 60 inches, gray (10YR 5/1) and yellowish-brown (10YR 5/4) gravelly sand; many, medium and coarse, distinct mottles; single grain; loose; strongly calcareous.

The color of the Ap horizon is very dark brown (10YR 2/2) or black (10YR 2/1). The total thickness of the A horizon is from 8 to 14 inches. Both silt loam and silty clay loam soils are mapped in the county. Silt loam is predominant.

The underlying material is stratified sand and gravel interspersed with layers of loamy material in some places.

The Westland soils occur beside areas of well-drained Wea and Ockley soils and very poorly drained Bonpas soils. They are coarser textured than the Bonpas soils.

Westland silt loam (Wn).—This soil lies along intermittent streams on small outwash plains. It is also in slight depressions on outwash terraces along streams, near the breaks to the uplands.

Included with this soil are a few areas that have a loam surface layer, small areas of the somewhat poorly drained Sleeth soils, and areas that are underlain by sandy loam or loam instead of sand and gravel.

Westland silt loam has very slow surface runoff. If drained, the soil has a deep root zone. Wetness is a slight limitation even if the soil is drained, however. Tilth of the surface layer is good. (Capability unit IIw-4)

Westland silty clay loam (Ws).—This soil lies along intermittent streams on outwash plains. It also occupies slight depressions on outwash terraces of larger streams, near the breaks to the uplands. This soil is similar to Westland silt loam, except for its silty clay loam surface layer.

Included with this soil are areas of the somewhat poorly drained Sleeth soils; areas that have a thicker, very dark colored surface layer; and areas that are underlain by sandy loam or loam instead of sand and gravel.

If drained, Westland silty clay loam has a deep root zone. Even after drainage, wetness is a continuing hazard. Tilth of the plow layer is good, but this soil must be tilled more carefully than Westland silt loam to prevent cloddiness. (Capability unit IIw-4)

Wynn Series

The Wynn series consists of well-drained, nearly level to sloping soils that are light colored and moderately deep. These soils have formed on uplands in silty wind-deposited material and thin layers of glacial till that overlie limestone and calcareous shale. Large areas are in Israel and Somers Townships. The native vegetation on these soils was a mixed stand of deciduous hardwoods.

A typical Wynn soil has a brown silt loam plow layer that is friable and granular. The subsoil, to a depth of about 26 inches, is brown silty clay loam in the upper part and brown clay loam in the lower part. Strong-brown, brown, and yellowish-brown clay overlies limestone bedrock that occurs at a depth of about 29 inches.

Uneroded Wynn soils have moderate or low available moisture capacity, depending on depth to bedrock. They have medium organic-matter content and moderately slow permeability. The depth of the root zone is limited by bedrock. These soils are mostly strongly acid or very strongly acid in the upper layers, but the lower part of the subsoil is slightly calcareous.

The Wynn soils are used for most crops commonly grown in the county. They need additions of lime and fertilizer, however.

Technical description of a profile of a formerly cultivated Wynn silt loam in a bluegrass pasture in Somers Township, SW $\frac{1}{4}$ sec. 29, T. 6 N., R. 2 E.:

- Ap—0 to 7 inches, brown (10YR 4/3) silt loam; moderate, fine and medium, granular structure; friable; strongly acid; roots abundant; boundary abrupt and smooth.
- B1—7 to 9 inches, brown (7.5YR 4/4) silty clay loam; dark grayish-brown (10YR 4/2) worm casts; moderate, fine, subangular blocky structure; friable; very strongly acid; roots plentiful; lower boundary clear and smooth.
- B21t—9 to 13 inches, brown (7.5YR 4/4) silty clay loam; dark grayish-brown (10YR 4/2) worm casts; moderate, fine, subangular and angular blocky structure; friable; roots plentiful; very strongly acid; lower boundary diffuse.
- B22t—13 to 20 inches, brown (7.5YR 4/4) silty clay loam; moderate, fine and medium, angular and subangular blocky structure; friable; roots plentiful; very strongly acid; lower boundary clear and smooth.
- IIB23—20 to 22 inches, brown (7.5YR 4/4) clay loam; moderate, medium, subangular blocky structure; friable; very strongly acid; lower boundary diffuse.
- IIB24—22 to 26 inches, brown (7.5YR 4/4) clay loam; weak, medium, subangular blocky structure; friable; very strongly acid; lower boundary clear and smooth.
- IIIB3—26 to 28 inches, mixed strong-brown (7.5YR 5/8), brown (7.5YR 4/4), and yellowish-brown (10YR 5/4) clay; medium subangular blocky structure; firm; slightly calcareous; boundary abrupt and smooth.
- IIIC—28 to 28 $\frac{1}{2}$ inches, $\frac{1}{4}$ to $\frac{1}{2}$ inch of very pale brown (10YR 7/4) weathered bedrock between IIIB3 horizon and bedrock (too thin to sample).
- IIIR—28 $\frac{1}{2}$ inches +, limestone bedrock.

The color of the surface layer is generally brown (10YR 4/3), but the range is from very dark grayish brown (10YR 3/2) to yellowish brown (10YR 5/4). The texture of the B horizons ranges from silty clay loam to clay. The clay texture of the IIIB3 horizon results from the influence of the underlying limestone or shale. The depth to interbedded limestone and calcareous shale ranges from 26 to 42 inches.

The Wynn soils are next to areas of the deeper Russell soils, moderately well drained Xenia and Corwin Soils, and the somewhat poorly drained Fincastle soils. They have a thicker layer of silty material over the till than the Milton soils.

Wynn silt loam, 2 to 6 percent slopes (W_yB).—Areas of this soil are above bedrock escarpments and on ridgetops.

Included with this soil are a few areas of well-drained Russell soils that are too small to be shown separately on the soil map. Also included are some areas in which only the top 15 to 18 inches consists of silty material.

This Wynn soil has medium surface runoff and a slight to moderate risk of erosion. (Capability unit IIe-1)

Wynn silt loam, 2 to 6 percent slopes, moderately eroded (W_yB2).—This soil occurs above bedrock outcrops where the soils are strongly sloping to very steep. Erosion has removed part of its original surface layer. The present plow layer is a mixture of the original plow layer and material from the subsoil.

Included with this soil are a few areas of well-drained Russell soils that are too small to be shown separately on the soil map.

This Wynn soil has a medium to low content of organic matter. Surface runoff is medium, and susceptibility to further erosion is moderate. In dry years crops are damaged by drought, especially in areas that are thinnest over bedrock. (Capability unit IIe-1)

Wynn silt loam, 6 to 12 percent slopes, moderately eroded (W_yC2).—This soil is along and at the heads of waterways. Erosion has removed much of the original surface layer. The present plow layer is mostly a mixture of the original surface layer and material from the subsoil.

This soil has low to moderate available moisture capacity and a low content of organic matter. As a result, tilth is poor. Surface runoff is rapid, and the root zone is shallow. In dry years crops are damaged by drought. (Capability unit IIIe-1)

Xenia Series

The Xenia series consists of deep, moderately well drained, nearly level and gently sloping soils. These soils have formed in calcareous glacial till mantled with silt. They occupy uplands in Israel, Dixon, Somers and Jackson Townships and in the southwestern corner of Gratis Township. The native vegetation was a mixed stand of deciduous hardwoods.

A typical cultivated Xenia soil has a dark grayish-brown silt loam plow layer that is friable. The subsoil is mostly silty clay loam in texture and is dark yellowish brown and yellowish brown. Below a depth of about 40 inches is loam till.

The Xenia soils are moderately slowly permeable, have medium organic-matter content, and have high available moisture capacity. The root zone is deep.

The Xenia soils are used for crops commonly grown in the county.

Technical description of a profile of Xenia silt loam in a cultivated field in Dixon Township, NW $\frac{1}{4}$ sec. 31, T. 7 N., R. 1 E.:

- Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; very thick platy structure breaking to weak, very fine and fine, crumb; friable; medium acid; lower boundary abrupt and smooth.
- A2—7 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, platy structure that breaks to weak, fine, crumb; friable; medium acid; lower boundary clear and smooth.
- B1—10 to 14 inches, silt loam that is dark yellowish brown (10YR 4/4) in ped interiors; brown (10YR 5/3) clay coatings; moderate, fine, subangular and angular blocky structure; friable; strongly acid; lower boundary clear and smooth.
- B21t—14 to 18 inches, silty clay loam that is dark yellowish brown (10YR 4/4) in ped interiors; brown (10YR 5/3) clay coatings; dark brown (10YR 4/3) when crushed; moderate, medium, angular blocky structure; friable; strongly acid; lower boundary diffuse.
- B22t—18 to 23 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, medium, distinct, pale-brown (10YR 6/3) mottles; dark-brown (10YR 4/3) clay films on ped surfaces; strong, fine and medium, angular blocky structure; firm; very strongly acid; lower boundary diffuse.
- B23t—23 to 28 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, pale-brown (10YR 6/3) mottles; moderate, fine and medium, subangular and angular blocky structure; firm; very strongly acid; lower boundary diffuse.
- B24t—28 to 34 inches, yellowish-brown (10YR 5/4) silt loam; common, medium, distinct, pale-brown (10YR 6/3) and brown (10YR 5/3) mottles; moderate, fine and medium, subangular and angular blocky structure; firm; very strongly acid; lower boundary diffuse.
- B25—34 to 41 inches, yellowish-brown (10YR 5/6) silt loam; common, medium, distinct, pale-brown (10YR 6/3) and brown (10YR 5/3) mottles; very dark grayish-brown (10YR 3/2) clay pockets; dark yellowish brown

(10YR 4/4) when crushed; weak, fine and medium, subangular and angular blocky structure; firm; strongly acid; lower boundary clear and wavy.

IIB31—41 to 46 inches, yellowish-brown (10YR 5/6) loam; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; very dark grayish-brown (10YR 3/2) clay pockets; weak, fine and medium, subangular blocky structure; firm; a few till pebbles; medium acid; lower boundary clear and wavy.

IIB32—46 to 54 inches, loam that is dark brown (10YR 4/3) when crushed; some very dark grayish-brown (10YR 3/2) clay pockets; weak, fine and medium, subangular blocky structure; friable; slightly acid; about 2 percent of soil mass consists of till pebbles less than one half inch in diameter; lower boundary clear and wavy.

IIC1—54 to 60 inches, loam that is dark brown (10YR 4/3) when crushed; massive; friable; weakly calcareous; 2 to 5 percent of soil mass consists of till pebbles less than 2 inches in diameter.

IIC2—60 to 84 inches, strongly calcareous loam till that is dark yellowish brown (10YR 4/4) when crushed; some grayish-brown (10YR 5/2) streaks; 5 to 8 percent of soil mass consists of till pebbles less than 2 inches in diameter.

The thickness of the loess capping is generally about 26 inches, but it ranges from 18 to 40 inches. It is variable within short distances. Where the loess is near the minimum thickness for the Xenia series, the texture of the lower B horizon is silty clay loam.

Depth to mottling ranges from 16 to about 30 inches. Depth to calcareous till ranges from 34 to 56 inches. The till is most commonly of loam texture, but the range is from loam to silt loam and clay loam.

The Xenia soils are the moderately well drained member of the Russell-Xenia-Fincastle-Brookston drainage sequence. They are similar to Celina soils except for their thicker mantle of silt. The Xenia soils are similar to Birkbeck soils except for their thinner mantle of silt.

Xenia silt loam, 0 to 2 percent slopes (XeA).—This soil occurs along waterways and in areas between the Brookston soils in depressions and the steeper Russell soils.

Included with this soil are areas of the somewhat poorly drained Fincastle soils that are too small to be shown separately on the soil map. These included soils have gray and yellow mottling within 12 inches of the surface. This indicates restricted internal drainage.

The tilth of this Xenia soil is excellent. The surface layer is slightly acid to medium acid. There is little or no hazard of erosion. (Capability unit I-1)

Xenia silt loam, 2 to 6 percent slopes (XeB).—This soil occupies low knolls, long gentle slopes, and wide ridgetops.

Included with this soil are small areas of the somewhat poorly drained Fincastle soils that are too small to be shown separately on the soil map. These included soils have gray and yellow mottling within 12 inches of the surface. This indicates restricted internal drainage.

This Xenia soil has excellent tilth, but erosion is a moderate hazard when it is cultivated. (Capability unit IIe-1)

Xenia silt loam, 2 to 6 percent slopes, moderately eroded (XeB2).—This soil occurs on low knolls, long gentle slopes, and ridgetops. Part of the original surface layer has been removed by erosion, and the present plow layer is a mixture of surface soil and material from the subsoil. Erosion has decreased the content of organic matter.

Included with this soil are some areas of well-drained Russell soils that are too small to be shown separately on the soil map.

The surface layer of this Xenia soil is slightly acid to medium acid. When cultivated, this soil has moderate susceptibility to erosion. (Capability unit IIe-1)

Formation and Classification of the Soils

In this section the factors of soil formation are discussed, with particular emphasis on the formation of the soils in Preble County. Then, the classification of the soils is discussed, and the new and the old systems of soil classification are shown.

Some of the soils were sampled in the field and tested by the Ohio Agricultural Research and Development Center. Data obtained from these tests are given.

Factors of Soil Formation

Soils are the products of soil-forming processes acting on materials that were deposited or accumulated by geologic processes. The important factors in soil formation are parent material, climate, relief or topography, living organisms, and time.

Climate and living organisms, particularly vegetation, are the active factors of soil formation. Their effects on the parent material are modified by relief and by the length of time the parent material has been acted upon. The relative importance of each factor differs from place to place. In some places, one factor dominates and is responsible for most of the soil properties, but normally the interaction of all five factors determines the kind of soil.

Parent material

The soils of Preble County have developed in several kinds of parent materials. These materials are glacial drift, weathered products of sedimentary bedrock, loess, lacustrine deposits, and alluvium from these materials. Many soils developed in combinations of the materials named.

Glacial drift, a general term applied to till and to outwash sand and gravel, is the most extensive of the parent materials in the county. Several of the soils developed in till that was capped with loess up to 18 inches in thickness. Examples of soils in till overlain by thin loess are the Miami and Corwin. The till is homogeneous and uniform in texture, and the soils that developed in this parent material have rather uniform, moderately fine to fine texture in the subsoil layers. Soils that developed in till overlain by more than 18 inches of loess include the Russell and the Xenia. The upper subsoil of these soils is more silty than that of soils in which the loess cap is thin.

Deposits of outwash sand and gravel were laid down by melt water that flowed in the glacial streams. This coarse material was fairly well sorted. Much of it was then covered by finer textured material, mostly loamy outwash, and soils such as the Ockley, Wea, Westland, and Sleeth were developed in those materials. Ockley and Wea soils have developed strong-brown and reddish colors of the parent outwash, but in Westland and Sleeth soils, formed in similar materials, the color is dominantly gray as a result of slow drainage and poor aeration. Fox, Rodman, and Casco soils have developed in the sorted coarse sand

and gravel where little of the loamy outwash layer was originally present or where it has been removed by geologic erosion. These soils are thin and droughty, and most of them have a gravelly solum and substratum.

Limestone and clay shale of the bedrock formation have influenced some of the soils. Lower horizons of the Milton, Millsdale, and Wynn soils have developed in parent material that was mostly the weathering product of the bedrock. The deep layers of these soils have the color of the weathered bedrock. Olive brown and olive gray predominate in the layers that are weathered Ordovician shale, and reddish hues are prevalent where the rock was Silurian limestone. Fairmount soils have developed entirely on the weathered Ordovician shale.

Areas of lacustrine material (lake-bottom sediments) are minor in the county. Lacustrine deposits of thinly layered silt and clay were the parent material of the subsoil of the Bonpas soils.

Alluvial deposits left by floodwaters are the youngest parent materials of soils in the county. These materials are still accumulating whenever fresh sediment is added by stream overflow. The sediment was derived mainly from the surface layers of the higher lying soils. Soils in alluvial deposits, such as the Ross and Medway, are dark, fertile soils.

Climate

The climate of Preble County during formation of the soils has been favorable for physical and chemical weathering and for biological activity.

Rainfall has been enough to supply adequate percolating water. Carbonates have been leached to a moderate depth; for example, in Birkbeck, Celina, and Xenia soils. Frequent rains have produced wetting and drying cycles that favor translocation of clay minerals and formation of soil structure. The structure is moderate or strong in Miami, Russell, and Ockley soils.

Temperature variations have been in a range that favored physical and chemical weathering. Freezing and thawing have aided in the development of soil structure. The warm summers have favored chemical weathering.

Both rainfall and temperature have been favorable for plant growth and subsequent accumulation of organic matter in such soils as the Corwin, Brookston, and Wea.

Topography

Topography can account for the development of different soils in the same kind of parent material. The effect of topography is illustrated by the Hennepin, Miami, Celina, Crosby, and Brookston soils. All of them were formed in glacial till. The moderately well drained Celina and the well drained Miami soils have a moderately thick solum. They were formed where the slope was not so strong as to encourage excessive erosion and not so nearly level as to prevent runoff. The well-drained Hennepin soils have a thin solum. They developed where the slope is strong enough that soil was removed by erosion almost as fast as it was formed. The somewhat poorly drained Crosby soils developed in nearly level places where runoff is slow. The very poorly drained, dark Brookston soils are in the nearby swales where organic residues accumulated as a result of the high water table that is present for most of the year. The gently sloping or sloping Miami and Celina soils and

the steep Hennepin soils are dominant in the morainic areas. The level or very gently undulating Brookston and Crosby soils are on the till plains.

Living organisms

The vegetation at the time of settlement in Preble County was hardwood forest in which beech, maple, oak, hickory, and ash were the most abundant trees. Grassy clearings on the well-drained sites and marshy openings in the poorly drained swales were also present.

Soils that were formed in the forest areas are light colored, acid, and moderately fertile. They include Miami, Crosby, and Reesville soils. The well-drained soils of the grassy clearings are dark, less acid, and more fertile. Examples are the Corwin and Dana. In the marshy swales there are very poorly drained, dark, fertile soils, such as the Brookston, Millsdale, and Ragsdale.

Small animals, insects, worms, and roots form channels that make the soil permeable. Animals mix the soil materials and contribute organic matter. Worm channels or casts are common in the highly organic surface layer of Corwin and Dana soils. Crawfish channels are common in the very poorly drained soils, such as Brookston, Westland, and Bonpas.

Time

Time is needed for the other soil-forming factors to produce their effects. The age of a soil is indicated, to some extent, by the degree of development of its profile. In many places, however, the factors other than time have been responsible for most of the differences in kind and distinctness of horizons in the different soils. If the parent material weathers slowly, as does that of the Fairmount soils, the profile develops slowly. The profile of a gently sloping soil in glacial till or in loess develops more rapidly. If the slopes are steep, so that soil is removed almost as fast as it is formed, distinct horizons are not developed. The Rodman soils do not have distinct horizons.

Most soils in the county, however, have well-developed profiles. Examples are the Russell, Miami, Ockley, Celina, and Crosby. But on flood plains, frequent deposits of fresh sediment prevent the development of a distinct profile. Ross and Medway are examples of young soils in which horizons are not well developed.

Processes of Soil Formation

The soils that make up most of the acreage in Preble County have rather strongly developed profiles. The processes of soil formation have produced distinct changes in the parent material. The well-developed soils are undulating to rolling, and they developed in deposits of glacial till and in terraces of glacial outwash that are along the major valleys. In a small part of the county, the parent materials have been only slightly modified by the processes of soil formation. Some of these soils are on flood plains, and some are steep.

All the factors of soil formation act in unison to control the processes by which horizons are formed. These processes are of four kinds: (1) Additions, (2) losses, (3) transfers, and (4) transformations. Some of these changes promote the formation of horizons, but others retard the formation of horizons or obliterate differences that are already present.

In this region the most evident additions to the soil are those of organic matter. Soils that have formed under deep-rooted grasses, or where a high water table has restricted decomposition of organic matter, have a deep, dark-colored surface horizon. It has high content of organic matter, has good structure, and its base saturation exceeds 50 percent. These properties describe the dark surface horizon of the Brookston or Warsaw soils.

Some organic matter accumulates as a thin surface mat in most of the soils. This dark layer is generally obliterated by cultivation. Severe erosion can remove all evidence that a dark layer was formed by addition of organic matter to the soil.

Leaching of carbonates from calcareous parent material is one of the most significant losses that preceded many other chemical changes in the solum. Other minerals in the soil are also subject to chemical weathering and leaching, but their resistance is higher than that of the carbonates, and loss by leaching is slower. After carbonates are leached, alteration of minerals, such as biotite and feldspars, produces changes of color within the profile. Free iron oxides are produced, and they are segregated by a fluctuating water table to produce a gray, mottled subsoil, such as that of the Brookston and Bonpas soils. If ground water is not within the profile, brownish colors of stronger chroma or redder hue than those of the C horizon will develop.

Seasonal wetting and drying appear to be largely responsible for the transfer of clay from the A horizon to the ped surfaces in the B horizon. The fine clay becomes suspended in percolating water that moves through the surface layer and is carried by the water to the subsoil. There, the fine clay is deposited on the ped surfaces by drying or by precipitation caused by free carbonates. The transfer of fine clay accounts for the nearly continuous clay coatings on ped surfaces in the B horizon of such soils as the Russell and Ockley.

Transformations of mineral compounds occur in most soils. The results are most apparent if the development of horizons is not affected by rapid erosion or by accumulation of material at the surface. The primary silicate minerals are weathered chemically to produce secondary minerals, mainly those of the layer-lattice silicate clays. Most of the layer-lattice clays remain in the soil profile, but clay from the A horizon is transferred to deeper horizons. In studies of the Miami soils (12), illite was found to be the most common clay mineral in the loamy glacial till. Illite is altered by weathering, and only a minor amount of it remains in the surface horizon of Miami soils. Vermiculite is the dominant mineral in the small amount of clay that remains in the A horizon of these soils. Montmorillonite, vermiculite, and illite occur in about equal amounts in the B horizon, where a large amount of clay has accumulated. Kaolinite, a clay mineral that indicates fairly intense weathering, is present only in minor amounts in the Miami and in most other soils of 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 relationships to one another and to the whole environment, and to develop principles that help us to understand their be-

havior and their response to manipulation. First, through classification, and then through use of soil maps, we can apply our knowledge to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow classes that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes of more general categories to facilitate study and comparison in large areas, 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 (14) and revised later (13). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study (9, 16). Therefore, readers interested in developments of the system should search the latest literature available.

Under the current system of classification, six categories are recognized. Beginning with the broadest and most inclusive, these are the order, the suborder, the great group, the subgroup, the family, and the 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. The family, subgroup, and order for each soil series in the county, under the current classification, are shown in table 8. This table also shows great soil groups of the 1938 classification.

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 the soils. Two exceptions are Entisols and Histosols, which occur in many different climates. Three soil orders are represented in Preble County. They are Inceptisols, Mollisols, and Alfisols.

Inceptisols are mineral soils in which horizons have started to develop but which 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.

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

TABLE 8.—*Soil series classified according to the current system of classification and the 1938 system with its later revisions*

Series	Current classification ¹			Great soil groups of the 1938 classification
	Family	Subgroup	Order	
Birkbeck	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Bonpas	Fine-silty, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols	Humic Gley soils.
Brookston	Fine-loamy, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols	Humic Gley soils.
Casco	Fine-loamy, over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Celina	Fine, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Channahon	Loamy, mixed, mesic	Lithic Argiudolls	Mollisols	Brunizems.
Corwin	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols	Brunizems.
Crane	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols	Brunizems.
Crosby	Fine-loamy, illitic, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils.
Dana	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols	Brunizems.
Fairmount	Fine, mixed, calcareous, shallow mesic	Typic Hapludolls	Mollisols	Rendzinas.
Fincastle	Fine-silty, mixed, mesic	Aquic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Fox	Fine-loamy, over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Hennepin	Fine-loamy, mixed, mesic	Typic Entrochrepts	Inceptisols	Regosols intergrading toward Gray-Brown Podzolic soils.
Kendallville	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Landes	Coarse-loamy, siliceous, mesic	Fluventic Hapludolls	Mollisols	Alluvial soils.
Lewisburg	Fine, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils intergrading toward the Regosols.
Medway	Fine-loamy, mixed, mesic	Fluventic Hapludolls	Mollisols	Alluvial soils.
Miami	Fine-loamy, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Millsdale	Fine, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols	Humic Gley soils.
Milton	Fine, illitic, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Ockley	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Odell	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols	Brunizems.
Plattville	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols	Brunizems.
Pymont	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols	Gray-Brown Podzolic soils intergrading toward Regosols.
Ragsdale	Fine-silty, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols	Humic Gley soils.
Randolph	Fine, illitic, mesic	Aquic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Raub	Fine-silty, mixed, mesic	Aquic Argiudolls	Mollisols	Brunizems.
Reesville	Fine, illitic, thin, mesic	Aquic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Ritchey	Clayey, mixed, mesic	Lithic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Rodman	Loamy-skeletal, carbonatic, mesic	Entrochreptic Rendolls	Mollisols	Rendzinas.
Ross	Fine-loamy, mixed, mesic	Cumulic Hapludolls	Mollisols	Alluvial soils.
Russell	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Shoals	Fine-loamy, mixed, nonacid, mesic	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	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Tippecanoe	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols	Brunizems.
Warsaw	Fine-loamy, over sandy or sandy-skeletal, mixed, mesic	Typic Argiudolls	Mollisols	Brunizems.
Wea	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols	Brunizems.
Westland	Fine-loamy, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols	Humic Gley soils.
Wynn	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.
Xenia	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols	Gray-Brown Podzolic soils.

¹ Classification of some of the soils at the subgroup and family levels is tentative. Refinement of the classification system, and study of these soils in other areas, may result in some changes in the placement given in this table.

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 8, because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central, or typical, 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 9 were made of selected soils in Preble 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 alphabetic order in the section "Descriptions of the Soils."

In addition to the data given in table 9, data on mechanical analysis are available for soils in the following series: Birkbeck, Brookston, Fincastle, Fox, Hennepin, Kendallville, Medway, Miami, Millsdale, Milton, Ockley, Odell, Ragsdale, Randolph, Reesville, Rodman, Ross, Russell, Sloan, Thackery, Wea, Westland, Wynn, and Xenia. These data are on file in the Soils Department, Ohio State University; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and in the State Office, Soil Conservation Service, Columbus, Ohio.

Laboratory methods.—The data on particle size distribution shown in table 9 were obtained by the pipette method outlined by Steele and Bradfield (10), but using sodium hexametaphosphate as the dispersing agent and a 10 gram soil sample. The percentage of organic matter was determined by the wet oxidation procedures (5). Exchangeable calcium and magnesium were determined by the EDTA method (2). Potassium was determined by flame photometry. Exchangeable hydrogen, which includes titrable aluminum, was determined by the triethanolamine method (5), and cation exchange capacity by the summation of exchangeable cations. Calcium carbonate equivalent was determined titrimetrically by the procedure of Hutchison and MacLennan (6). All pH measurements were made by using a 1:1 soil-water ratio.

General Nature of the County

This section provides general information about Preble County. It describes the climate, discusses the water supply, and gives some facts about the agriculture. Agricul-

tural statistics were taken from records of the U.S. Bureau of the Census.

The first settlement in what is now Preble County was established by John Leslie along Elk Creek in Gratis Township in 1798. Later settlers, mainly from Virginia, Pennsylvania, North Carolina, and Kentucky, moved progressively west and north across the county. By 1803 all the townships, except Washington, Jefferson, and Monroe, had been settled. Preble County was formed on March 1, 1808; Eaton was designated as the county seat.

Climate⁴

In general, the climate of Preble County can be described as continental. Winters are relatively cold, and summers are moderately hot and humid. Precipitation is greatest in the warm season. The county does not have extreme seasonal variations in temperature and precipitation. Disastrous droughts, for example, are practically unknown. The southern border of Preble County gets roughly an inch more of precipitation per year than the northern border and is at least 1 degree warmer. Temperatures run about average for the State, but the county receives an inch or two more of precipitation.

Data on temperature and precipitation for Preble County given in table 10 are representative of the county, except for the northern and southern borders. Most of the statistics are for the station at Eaton, but average monthly precipitation is also given for West Manchester. Table 11 provides average dates of the first freezing temperatures in spring and fall. The growing season—the interval between the average last date of 32° F. temperature in spring and the first in fall—is 162 days.

Temperatures reach 100° F. only about once each summer, and the cooler summers may have only 5 or 6 days with readings above 90°. During winter there is an average of 3 or 4 days of zero weather, but occasionally there are no zero temperatures during winter. The depth of frost penetration depends on the severity of the season and whether the coldest weather comes when the ground is bare or covered with snow. In an average winter, only the top 6 to 8 inches of soil freezes, even on bare cultivated soils.

Mainly because of the higher temperatures, about 55 percent of the year's total moisture falls from April through September. This favors the growth of a wide variety of crops. Nevertheless, rainfall sometimes tends to be deficient during July and August, when the need for moisture is greatest, particularly for such crops as corn. Because of the natural recharge of ground water during winter, soil moisture usually equals or exceeds field capacity by April 1. In spring there is generally enough rainfall to maintain field capacity until early in May when use of moisture by vegetation normally begins to exceed rainfall. Thereafter, evapotranspiration losses drain moisture from the root zone faster than rainfall can replenish it. Consequently, the soils characteristically become somewhat dry by the end of August and sometimes earlier. Summer thunderstorms frequently supply needed rainfall, but the rain falls faster than soil can retain it.

A study of rainfall probabilities for this county shows that the chances are about two out of five that 1 inch will

⁴This section was prepared by L. T. PIERCE, State climatologist, Weather Bureau, U.S. Department of Commerce, Columbus, Ohio.

TABLE 9.—Physical and chemical

[Analyses made at Ohio Agricultural Research and Development Center, Ohio State

Soil name, profile number, and location	Sample number	Depth	Horizon	Particle-size distribution						
				Very coarse sand (2.0 to 1.0 mm.)	Coarse sand (1.0 to 0.05 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Total sand	Silt (0.05 to 0.002 mm.)
		<i>Inches</i>		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Celina silt loam; PB-59: 11 miles N. of Eaton.	11935	0-7	Ap	1.7	4.3	3.9	11.2	7.3	28.4	52.5
	11936	7-9	B1	1.3	3.4	3.2	8.5	6.2	22.6	38.7
	11937	9-12	B21t	1.7	3.6	3.5	7.8	6.2	22.8	33.5
	11938	12-18	B22t	1.2	2.9	3.2	8.2	7.0	22.5	37.0
	11939	18-24	B3t	1.8	3.8	3.5	9.5	9.6	28.2	37.9
	11940	24-29	C1	3.2	6.0	4.5	10.5	9.5	33.7	36.6
	11941	29-41	C2	3.3	7.4	5.3	12.3	10.5	38.8	39.2
Corwin silt loam; PB-39: T. 8 N., R. 1 E. sec. 18.	10786	0-7	Ap	1.1	2.7	4.2	9.4	5.7	23.1	57.1
	10787	7-10	A3	1.0	2.5	4.4	7.8	5.1	20.8	57.6
	10788	10-14	B1	1.0	2.7	4.3	8.4	4.7	21.1	52.5
	10789	14-18	B21t	.8	2.8	4.8	7.8	5.4	21.6	41.4
	10790	18-22	IIB22t	1.1	3.3	4.3	9.9	6.3	24.9	36.5
	10791	22-25	IIB23t	1.4	3.8	5.2	11.7	7.7	29.8	32.8
	10792	25-28	IIB3	1.3	5.8	5.4	4.2	18.5	35.2	29.1
	10793	28-34	IIC1	3.4	6.4	6.8	12.6	12.4	41.6	37.3
	10794	34-40	IIC2	3.4	7.1	7.9	13.5	13.0	44.9	38.3
	10795	40-50	IIC3	3.4	11.7	15.3	21.0	13.2	64.6	23.4
	10796	50-60	IIC4	4.5	8.6	10.6	18.9	13.5	56.1	32.8
Crosby silt loam; PB-2: 5 miles N. of Eaton.	4279	0-7	Ap	1.6	3.0	6.7	8.6	6.7	26.6	56.1
	4280	7-10	B1	.7	1.8	4.3	7.0	8.4	22.2	50.9
	4281	10-14	B21tg	.5	1.4	3.4	2.7	11.2	19.2	47.2
	4282	14-17	B22tg	.4	1.4	3.3	6.7	6.5	18.3	47.3
	4283	17-20	B23tg	.3	1.1	2.6	4.7	6.4	15.1	42.3
	4284	20-24	B3g	2.1	4.3	6.4	11.2	11.4	35.4	41.3
	4285	24-29	C1	4.5	7.2	8.3	10.2	14.4	44.6	40.1
	4286	29-34	C2	3.3	7.0	8.3	3.7	19.9	42.2	41.5
	4287	34-39	C3	2.8	6.9	9.8	12.3	17.8	49.6	38.0
	4288	39-44	C3	4.0	8.2	10.4	6.4	22.8	51.8	36.2
	Dana silt loam; PB-36: 11 miles S. and 5 miles W. of Eaton.	10756	0-7	Ap	1.3	1.0	1.0	2.4	2.3	8.0
10757		7-9	A1	.6	.8	.9	2.3	2.1	6.7	65.3
10758		9-12	B1	.3	1.5	.8	1.9	.9	5.4	59.8
10759		12-18	B21t	.3	.4	.6	1.9	1.7	4.9	58.8
10760		18-23	B22t	.2	.4	.5	1.4	1.8	4.3	60.9
10761		23-29	B31	.4	.5	.6	1.9	2.4	5.8	63.4
10762		29-34	B32	.3	.8	1.1	3.7	4.0	9.9	65.2
10763		34-40	IIB33	.7	1.7	2.0	7.0	7.4	18.8	60.9
10764		40-46	IIIC1	.7	1.7	3.7	28.1	24.6	58.8	31.2
10765		46-54	IIIC2	3.1	5.8	7.3	22.9	20.0	59.1	26.2
10766		54-63	IVC3	1.6	1.7	1.8	6.6	10.4	22.1	60.0
Miami silt loam; PB-4: 9 miles S. and 3 miles E. of Eaton.	4298	0-4	Ap1	1.4	2.6	6.1	10.6	9.0	29.7	52.3
	4299	4-7	Ap2	1.4	2.2	6.2	4.4	14.8	29.0	53.4
	4300	7-10	B1	1.4	2.9	6.5	4.4	13.6	28.8	36.6
	4301	10-14	B21t	1.1	3.1	6.5	10.3	7.4	28.4	33.1
	4302	14-18	B22t	1.0	2.9	7.0	2.3	17.4	30.6	31.5
	4303	18-22	B23t	.8	2.7	7.2	11.1	10.4	32.2	30.0
	4304	22-26	B3t	1.1	3.0	7.1	12.7	11.4	35.3	33.0
	4305	26-30	C1	2.1	3.7	6.4	10.1	10.3	32.6	41.0
	4306	30-35	C1	.6	1.6	2.9	5.6	6.1	16.8	60.0
	4307	35-40	C3	2.4	4.5	6.8	10.3	9.9	33.9	43.9
	4308	40-45	C3	3.2	5.7	8.5	6.0	18.4	41.8	39.6
Odell silt loam; PB-13: 7 miles S. and 4.5 miles W. of Eaton.	8478	0-7	Ap	1.0	1.8	4.9	9.5	7.1	24.3	56.5
	8479	7-12	B1	1.4	3.1	5.3	9.3	5.7	24.8	48.4
	8480	12-19	B21t	1.0	2.6	5.0	7.4	5.2	21.2	45.3
	8481	19-27	B22t	1.2	2.1	3.5	6.5	4.2	17.5	44.1
	8482	27-36	B3t	.7	2.2	3.6	7.4	6.4	20.3	43.2
	8483	36-46	C1	1.1	2.4	3.7	6.3	17.9	31.4	43.3
	8484	46-60	C2	1.2	3.3	5.3	10.0	9.0	28.8	41.2

data for selected soils

University, Columbus, Ohio. Absence of a figure indicates the determination was not made]

Particle-size distribution—Con.		USDA textural class	Reaction	Organic matter	CaCO ₃ equivalent	Extractable cations				Sum of cations	Sum of bases	Base saturation
Clay (less than 0.002 mm.)	Fine clay (less than 0.0002 mm.)					H	Ca	Mg	K			
Percent	Percent		pH	Percent	Percent	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Percent
19.1	3.7	Silt loam	7.1	2.7		3.2	9.2	3.4	0.16	16.0	12.8	80
38.7	15.2	Clay loam	7.2	1.1		3.9	12.2	5.4	.20	21.7	17.8	82
43.7	20.4	Clay	7.1	1.1		4.4	14.6	6.8	.27	26.1	21.7	83
40.5	17.8	Clay	7.4	1.0	1							
33.9	15.4	Clay loam	7.9		19							
29.7	12.8	Clay loam	7.9		32							
22.0	7.1	Loam	8.1		43							
19.8	2.6	Silt loam	5.1	3.9		10.6	4.9	5.0	.26	20.8	10.2	49
21.6	3.9	Silt loam	5.4	4.0		8.9	7.8	4.5	.21	21.4	12.5	57
26.4	8.0	Silt loam	5.8	3.0		7.6	9.4	6.0	.24	23.0	15.6	68
37.0	16.8	Clay loam	6.0	1.5		6.6	10.2	8.7	.29	25.8	19.2	74
38.6	18.5	Clay loam	6.3	1.2		5.8	10.1	10.1	.28	26.3	20.5	78
37.4	18.0	Clay loam	6.6	1.2		5.2	10.2	9.0	.26	24.7	19.5	79
35.7	16.1	Clay loam	7.1			3.3	10.4	8.1	.23	22.0	18.7	85
21.1	7.9	Loam	7.7		26							
16.8	5.8	Loam	7.8		33							
12.0	5.7	Silt loam	7.7		19							
11.1	3.0	Silt loam	8.0		30							
17.3	3.5	Silt loam	7.1	2.6		3.4	9.8	2.8	.18	16.2	12.8	79
26.9	9.2	Silt loam	6.9	1.1		4.2	8.9	3.7	.17	17.0	12.8	75
33.6	16.9	Silty clay loam	6.8	1.0		4.7	12.1	5.9	.27	23.0	18.3	80
34.4	15.4	Silty clay loam	7.1	.8		3.4	11.4	5.7	.27	20.8	17.4	84
42.6	21.4	Silty clay loam	7.2	.8		3.2	15.3	7.1	.36	26.0	22.8	88
23.3	11.2	Loam	7.8		28							
15.3	6.0	Loam	8.0		45							
16.3	6.3	Loam	8.1		46							
12.4	4.8	Loam	8.1		44							
12.0	4.9	Loam	8.1		44							
24.3	6.5	Silt loam	5.6	4.3		9.2	7.4	7.1	.31	24.0	14.8	62
28.0	9.1	Silty clay loam	5.6	3.3		8.7	8.9	7.4	.26	25.3	16.6	66
34.8	15.9	Silty clay loam	5.9	2.5		5.9	9.2	9.4	.29	24.8	18.9	76
36.3	18.8	Silty clay loam	6.1	1.1		5.9	10.2	10.3	.32	26.7	20.8	78
34.8	19.2	Silty clay loam	6.4	.8		4.2	9.8	9.7	.28	24.0	19.8	82
30.8	16.4	Silty clay loam	6.7			3.4	10.0	9.1	.22	22.7	19.3	85
24.9	12.3	Silt loam	7.2		<1	1.9	9.5	6.6	.18	18.2	16.3	90
20.3	9.5	Silt loam	7.5		8							
10.0	4.1	Sandy loam	7.6		14							
14.7	6.9	Sandy loam	7.4		17							
17.9	5.4	Silt loam	7.8		30							
18.0	6.7	Silt loam	5.9	1.5		5.5	4.6	1.8	.18	12.1	6.6	55
17.6	7.0	Silt loam	5.9	1.2		5.5	4.6	2.0	.18	12.3	6.8	55
34.6	17.1	Silty clay loam	4.9	.6		10.5	4.7	3.0	.31	18.5	8.0	43
38.5	21.4	Silty clay loam	4.9	.6		11.4	5.2	4.1	.36	21.1	9.7	46
37.9	20.6	Silty clay loam	5.0			9.4	5.8	5.2	.35	20.8	11.4	55
37.8	20.4	Silty clay loam	5.6			6.1	7.6	6.5	.31	20.5	14.4	70
31.7	16.2	Silty clay loam	7.2		10							
26.4	11.7	Loam	7.7		23							
23.2	13.5	Silt loam	7.9		26							
22.2	8.0	Loam	8.0		37							
18.6	6.0	Loam	8.0		41							
19.2	6.2	Silt loam	5.4	3.9		8.4	6.6	2.8	.26	18.1	9.7	54
26.8	10.3	Loam	6.0	1.0		5.6	7.8	4.8	.16	18.4	12.8	70
33.5	16.5	Clay loam	6.2	.8		4.6	9.0	8.8	.24	22.6	18.0	80
38.4	19.7	Clay loam	6.5	.6		4.6	9.2	11.7	.28	25.8	21.2	82
36.5	18.2	Clay loam	7.1	.4		2.3	10.0	9.0	.26	21.6	19.3	89
25.3	10.0	Loam	7.7		25							
30.0	13.6	Clay loam	7.7		18							

TABLE 9.—Physical and chemical

Soil name, profile number, and location	Sample number	Depth	Horizon	Particle-size distribution						
				Very coarse sand (2.0 to 1.0 mm.)	Coarse sand (1.0 to 0.05 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Total sand	Silt (0.05 to 0.002 mm.)
		<i>Inches</i>		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Pyrmont silt loam; PB-40: 7 miles E. and 5 miles N. of Eaton.	10797	0-7	Ap	2.0	3.3	3.0	6.4	5.6	20.3	60.9
	10798	7-10	B1g	1.2	3.4	3.7	7.7	5.8	21.8	55.6
	10799	10-13	B2tg	1.0	3.8	3.4	7.1	5.9	22.1	39.8
	10800	13-16	B3t	2.6	5.4	4.8	10.8	9.4	33.0	35.0
	10801	16-24	C1	4.2	7.0	5.3	12.1	11.5	40.1	39.2
	10802	24-32	C2	3.4	6.5	5.0	10.3	9.4	34.6	41.8
	10803	32-37	C3	3.8	7.6	5.0	10.7	9.8	36.9	38.6
	10804	37-45	C4	4.1	9.1	5.9	12.8	10.8	42.7	38.8
Raub silt loam; PB-12: 7 miles E. and 9 miles W. of Eaton.	8461	0-8	Ap	1.2	1.9	1.5	4.1	3.3	12.0	64.4
	8462	8-12	A1	1.1	2.7	3.3	4.6	3.2	14.9	59.6
	8463	12-17	A3	1.3	2.3	2.7	4.6	3.1	14.0	54.0
	8464	17-20	B1	1.3	1.8	2.2	3.2	2.5	11.0	52.6
	8465	20-26	B21t	1.3	1.9	1.9	3.7	3.8	11.3	54.4
	8466	26-36	B22t	.9	2.1	2.3	3.2	2.2	10.7	58.0
	8467	36-46	IB3t	2.6	5.6	7.0	11.3	6.8	33.3	41.7
	8468	46-56	IC1	2.6	5.6	7.7	14.0	9.2	39.1	33.9
8469	56-66	IC2	4.0	7.4	9.2	15.5	11.6	47.7	35.5	
Russell silt loam; PB-8: Heuston woods, 3 miles E. of College Corner.	5884	0-4	A1	.3	.5	.5	.7	.7	2.7	74.6
	5885	4-8	A2	.3	.8	.9	1.1	1.1	4.2	72.1
	5886	8-11	A3	.4	.6	.8	1.1	.9	3.8	67.4
	5887	11-16	B1t	.1	.3	.4	.7	.9	2.4	61.0
	5888	16-21	B21t	.1	.2	.3	.5	.9	2.0	62.1
	5889	21-25	B22t	.1	.2	.4	.8	1.1	2.6	65.4
	5890	25-30	B22t	.3	.4	.6	1.1	1.7	4.1	67.1
	5891	30-34	B23t	.4	.7	1.0	1.9	2.2	6.2	66.5
	5892	34-39	B23t	.7	1.9	2.7	3.9	3.0	12.2	60.5
	5893	39-44	B3	4.7	7.2	9.1	11.2	6.5	38.7	29.2
	5894	44-50	B3	2.3	6.7	9.4	14.3	10.1	42.8	27.8
	5895	50-60	C1	4.8	7.4	8.1	12.7	11.2	44.2	9.9
	5896	60-72	C2	12.7	8.2	7.8	11.9	10.7	51.3	35.2
	5897	72-84	C2	7.0	8.1	8.3	13.8	11.6	48.8	38.9
5898	84-93	C3	8.7	7.7	7.8	12.2	10.1	46.5	42.8	
5899	93-104	C3	5.2	5.9	7.1	13.3	12.9	44.4	46.5	
Tippocanoe silt loam; PB-37: 7 miles W. and 4 miles N. of Eaton.	10767	0-6	Ap	1.6	3.2	4.7	9.4	5.3	24.2	45.8
	10768	6-8	A12	1.4	3.5	4.9	8.9	4.7	23.4	47.6
	10769	8-13	A13	.9	4.1	5.6	9.8	4.2	24.6	43.5
	10770	13-18	A14	1.6	4.9	6.7	10.3	3.6	27.1	39.2
	10771	18-22	B1t	1.3	4.9	6.6	10.8	3.2	26.8	40.7
	10772	22-30	B21t	1.1	5.7	7.4	11.0	3.3	28.5	40.3
	10773	30-37	B22t	2.1	10.7	11.9	17.8	4.4	46.9	27.3
	10774	37-42	IB3t	3.4	19.1	19.2	25.3	4.7	71.7	10.8
	10775	42-50	IC1	3.0	12.4	16.0	35.3	11.7	78.4	17.9
	10776	50-60	IC2	6.8	24.5	19.9	25.2	6.8	83.2	15.8
	10777	60-65	IC3	9.5	22.0	12.0	17.3	8.1	68.9	26.6

data for selected soils—Continued

Particle-size distribution—Con.		USDA textural class	Reaction	Organic matter	CaCO ₃ equivalent	Extractable cations				Sum of cations	Sum of bases	Base saturation
Clay (less than 0.002 mm.)	Fine clay (less than 0.0002 mm.)					H	Ca	Mg	K			
Percent	Percent		pH	Percent	Percent	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Meq./100 gm.	Percent
18.8	3.6	Silt loam	5.9	1.0		5.4	7.4	2.7	.26	15.8	10.4	66
22.6	5.7	Silt loam	6.4	.4		4.0	8.2	3.3	.16	15.7	11.7	75
38.1	15.4	Clay loam	6.7			4.1	13.1	6.7	.28	24.2	20.1	83
32.0	11.9	Clay loam	7.3		14							
20.7	6.7	Loam	7.8		33							
23.6	5.6	Loam	8.0		37							
24.5	5.8	Loam	7.9		34							
18.5	4.7	Loam	7.9		42							
23.6	4.0	Silt loam	5.8	4.7		9.5	9.5	6.9	.28	26.2	16.7	64
25.5	7.0	Silt loam	6.0	4.4		7.8	11.3	8.8	.27	28.2	20.4	72
32.0	13.5	Silty clay loam	6.2	2.8		4.9	9.9	9.2	.28	24.3	19.4	80
36.4	19.5	Silty clay loam	6.2	1.2		4.6	13.0	10.2	.29	28.1	23.5	84
34.3	18.0	Silty clay loam	6.4			4.4	11.4	9.4	.25	25.5	21.1	83
31.3	17.2	Silty clay loam	6.6			4.4	8.5	9.2	.22	23.3	18.9	81
25.0	11.1	Loam	7.0			3.3	7.0	4.8	.17	15.3	12.0	79
27.0	10.4	Loam	7.6		4							
16.8	5.8	Loam	8.0		22							
22.7	9.1	Silt loam	6.2	5.1		9.9	12.7	2.6	.43	25.6	15.7	61
23.7	7.9	Silt loam	5.6	1.8		9.9	8.0	1.9	.18	20.0	10.1	50
28.8	12.5	Silty clay loam	5.6	1.2		9.5	8.6	2.6	.23	20.9	11.4	55
36.6	20.9	Silty clay loam	5.4	.7		10.8	10.5	3.9	.33	25.5	14.7	58
35.9	21.9	Silty clay loam	5.2	.4		11.8	9.2	4.9	.33	26.2	14.4	55
32.0	21.7	Silty clay loam	5.2	.3		10.1	7.4	4.9	.26	22.7	12.6	56
28.8	16.5	Silty clay loam	5.3	.4		9.2	6.5	4.1	.24	20.0	10.8	54
27.3	15.5	Silty clay loam	5.3	.1		8.6	6.7	4.1	.24	19.6	11.0	56
27.3	15.8	Silty clay loam	5.4	.1		7.4	7.0	4.6	.22	19.2	11.8	61
32.1	19.3	Clay loam	6.2			6.4	9.1	5.5	.28	21.3	14.9	70
29.4	14.6	Clay loam	7.1			4.2	9.7	5.7	.21	19.8	15.6	79
15.9	4.9	Loam	7.9		31							
13.5	4.5	Loam	8.0		41							
12.3	3.9	Loam	8.0		41							
10.7	3.5	Loam	8.0		44							
9.1	3.5	Loam	7.9		41							
30.0	7.4	Clay loam	5.5	4.3		11.0	9.9	6.9	.31	28.1	17.1	61
29.0	7.1	Clay loam	5.5	4.1		10.8	9.3	8.1	.26	28.5	17.7	62
21.9	10.1	Clay loam	5.7	3.7		8.5	11.5	7.7	.28	28.0	19.5	70
33.7	12.5	Clay loam	5.9	2.9		7.2	12.6	7.0	.28	28.0	20.8	74
32.5	13.6	Clay loam	5.9	2.5		6.7	14.4	6.1	.28	27.5	20.8	76
31.2	15.5	Clay loam	6.1			5.1	13.1	6.1	.28	24.6	19.5	79
25.8	12.0	Loam	6.4			3.8	6.8	6.2	.24	19.0	15.2	80
17.5	8.1	Silt loam	6.5			2.5	4.8	6.1	.16	13.6	11.1	82
3.7	.4	Loamy sand	7.5		27							
1.0	.3	Sandy loam	7.8		32							
4.5	1.6	Sandy loam	7.7		43							

TABLE 10.—Temperature and precipitation data

Month	Temperature					Precipitation					
	Average daily ¹			Two years in 10 will have at least 4 days with ² —		Average monthly		Extremes ³		Average number of days with snow cover ⁴	Average depth of snow on days with snow cover
	Maximum	Minimum	Mean	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Eaton	West Manchester	Wettest month	Driest month		
°F.	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches		Inches	
January	38.2	20.4	29.3	50	—3	3.53	3.35	12.53	0.44	19	0.9
February	40.7	21.1	30.9	58	6	2.68	2.55	5.58	.42	11	.7
March	49.8	27.2	38.5	68	9	3.55	3.33	8.52	.59	9	.7
April	62.2	38.4	50.3	82	24	3.59	3.46	7.96	.86	1	.1
May	74.2	47.8	61.0	86	33	3.92	3.86	9.78	.21	0	-----
June	83.9	56.5	70.2	90	46	4.42	4.47	9.76	.69	0	-----
July	87.8	61.8	74.8	92	52	3.52	3.27	9.21	.70	0	-----
August	86.8	58.8	72.8	93	50	3.02	3.12	8.59	.44	0	-----
September	80.5	51.3	65.9	92	39	3.04	2.82	7.51	.50	0	-----
October	68.5	40.7	54.6	82	28	2.47	2.55	7.13	.11	0	-----
November	52.0	30.8	41.4	67	17	2.89	2.88	6.33	.31	5	1.2
December	40.0	21.6	30.8	57	—3	2.55	2.64	5.05	.42	15	1.5
Year	63.7	39.7	51.7	-----	-----	39.18	38.30	53.88	23.81	60	.8

¹ Based on records for 1956–61, compared with records from stations at Dayton and Greenville, and then computed from Dayton and Greenville normals for 1931–60.

² Based on records for 1956–61.

³ Based on records for 1915–61.

⁴ Based on records for 1950–61.

TABLE 11.—Probabilities of last freezing temperature in spring and first in fall

Probability	Dates for given probability and temperature					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
Spring:						
1 year in 10 later than	March 23	April 2	April 16	May 1	May 15	May 27
2 years in 10 later than	March 16	March 26	April 9	April 26	May 10	May 22
5 years in 10 later than	March 4	March 14	March 28	April 12	April 27	May 9
Fall:						
1 year in 10 earlier than	November 14	November 3	October 22	October 9	September 26	September 14
2 years in 10 earlier than	November 21	November 10	October 29	October 17	October 4	September 21
5 years in 10 earlier than	December 1	November 21	November 9	October 27	October 14	October 1

fall each week during mid-June but that by late in July or early in August the chances drop to two or three out of 10. One inch per week comes close to meeting the moisture requirements of growing crops in summer. Therefore, crops must draw heavily on stored moisture to maintain optimum growth in an average season.

Tornadoes can be expected to strike within the county only once every 4 or 5 years. Even then, the typical tornado has a short, narrow path.

Water Supply

The supply of underground water in Preble County was generally sufficient for the normal farm operations in 1961. Eaton and most of the villages are along streams and receive an abundant supply of water from the lower slopes

and stream valleys. The wells, which are in sand and gravel, supply large quantities of water.

About 87 percent of the county is made up of ground or end moraines that consist chiefly of compact, largely impervious till deposited by the ice sheet. These deposits normally supply less than 10 gallons of water per minute (4). The bedrock that underlies the till and outwash material is a poor source of water. Of the two major limestone systems, Silurian and Ordovician, the Silurian supplies the most water.

There are many dug wells in the county. These are especially valuable where the water supply is derived from till or limestone because they provide a large area for infiltration and also storage space for water between periods of pumping.

Farm ponds and springs supply water for livestock.

Agriculture

Large areas of level to nearly level, fertile soils have made Preble County highly suitable for crops. The early settlers chose the better drained soils of the uplands, terraces, and first bottoms. Every township had areas of swampy and wet soils that were used for pasture. The largest area of these soils, sometimes referred to as Malaria Flats in pioneer days, is in the western half of Dixon Township and in the southwestern corner of Jackson Township. Such areas were the last to be settled because they needed extensive tile drains and open ditches to carry the excess water from the soils. Although these areas were the last to be settled, the soils, when drained, proved to be the most suitable for crops. They were especially suitable for corn, grown as feed for hogs. Farmers became highly successful in raising hogs and worked at improving the breeds, notably Poland China, Duroc-Jersey, and Chester White. Their interest in hog raising is evidenced by the many blue ribbons won in competition at State and county fairs.

Land use and size of farms

The total land area of Preble County is 273,280 acres. Of this, 232,186 acres was in farms in 1964. The number of farms gradually decreased from 2,769 in 1930 to 1,820 in 1964, but the average size of farms increased from 93.4 acres to 127.6 acres.

The acreage of woodland is decreasing. In 1964 only 9,630 acres remained in woodland that was not pastured. As the early settlers cleared their farms, they usually left an area of woodland that was wet, hard to get to, or too rough for good cropland. With improved methods of drainage and better farm machinery, these small woodlots are gradually being converted to cropland.

Crops

In Preble County, field crops are grown mainly to provide feed for livestock. The four principal feed crops—corn, wheat, oats, and hay—occupied more than half of the acreage in farms in 1964. Corn, the main field crop, was grown on nearly a third of the acreage.

Acreages of principal crops in 1964 were as follows: Corn grown for all purposes, 78,066; wheat harvested, 22,724; oats harvested for grain, 8,454; soybeans harvested for beans, 8,951; alfalfa and alfalfa mixtures cut for hay, 11,046; clover and timothy mixtures cut for hay, 10,814; small grains cut for hay, 443; corn silage, 2,983; grass silage, 592; and tobacco, 199.

Since 1939, the acreage in corn, oats, and soybeans has increased, while the acreage in wheat has decreased. An increasing amount of corn, grass, legume, and small grain silage is being made. Tobacco acreage has decreased greatly since 1939. In 1964 tobacco provided a substantial source of income for only 54 farms.

Livestock and livestock products

In 1964 most of the farm income in Preble County was derived from the sale of livestock and livestock products. The county ranks fourth in the state in the production of hogs. Roughly half of the farm income comes from the sale of hogs and pigs.

In 1964 the numbers of different kinds of livestock were as follows: Hogs and pigs, 97,693; cattle and calves, 35,708;

milk cows, 6,191; sheep and lambs, 6,997; and chickens, 4 months old and over, 133,744.

The number of hogs and pigs has increased considerably since 1940. The number of cattle and calves also has increased, but the number of milk cows has declined.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held together in a single mass or cluster, such as a clod, crumb, block, or prism.

- Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.
- Available moisture capacity.** The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.
- Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
- Calcareous.** A soil or soil layer containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.
- Catena.** A sequence, or chain, of soils on a landscape, developed from one kind of parent material but having different characteristics because of differences in relief and drainage.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- 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.
- Contour tillage.** Plowing, cultivating, planting and harvesting in rows that are at right angles to the natural direction of slope.
- Diversion, or diversion terrace.** A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.
- Drainage, soil.** The relative rapidity and extent of removal of water from on and within the soil, under natural conditions. Terms commonly used to describe drainage classes of soils are as follows:
- Very poorly drained.*—Water is removed so slowly that the soil remains wet most of the time and water ponds on the surface frequently.
- Poorly drained.*—Water is removed so slowly that the soil is wet for a large part of the time.
- Somewhat poorly drained.*—Water is removed slowly enough to keep the soil wet for significant periods but not all of the time.
- Moderately well drained.*—Water is removed from the soil somewhat slowly so that the profile is wet for a small but significant part of the time.
- Well drained.*—Water is removed from the soil readily but not rapidly.
- Excessively drained.*—Water is rapidly removed from the soil.
- Eluviation.** The movement of material from one place to another within the soil, in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial.
- End moraine.** Belt of sharply rolling or hummocky land composed of till deposited along the roughly continuous edge of a glacier. An end moraine marks the position of the ice during a halt or minor readvance.
- Erosion.** The wearing away of the land surface by wind, running water, and other geological agents.
- Flood plain.** Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.
- Glacial outwash.** Crossbedded gravel, sand, and silt deposited by melt water as it flowed from glacial ice.
- Glacial till.** Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
- Glaciofluvial deposits.** Material moved by glaciers and subsequently sorted and deposited by streams flowing from melting ice; the deposits are stratified and occur in the form of kames, eskers, deltas, and outwash plains.
- Gleization.** The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the subsoil or substratum, as a result of poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.
- Gravel.** Stone fragments consisting of rounded pebbles 2 millimeters to 3 inches in diameter.
- Ground moraine.** Smooth-surfaced deposits of till forming fairly flat land; deposited by ice that advanced over smooth bedrock and older glacial deposits.
- Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.
- 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 it is therefore 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 structures; (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. This layer is presumed to be like that from which the overlying horizons were formed in most soils. If the underlying 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.
- Illuviation.** The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.
- Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.
- Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.
- Lacustrine deposits.** Sediment deposited out of still or slack water and exposed by the lowering of the water level or the elevation of the land.
- Leaching.** The removal of soluble materials from soils or other material by percolation.
- Loess.** A fine-grained eolian (wind-carried) deposit consisting dominantly of silt-sized particles.
- Mottled.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.
- Neutral soil.** See Reaction.
- Outwash plain.** Smooth-surfaced deposit of horizontally bedded sand and gravel.
- Parent material.** The horizon of weathered rock or partly weathered soil material from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Percolation. The downward movement of water through the soil.

Permeability. The quality of a soil horizon that enables water or air to move through it. The permeability classes are (1) *very slow*, less than 0.063 inch per hour; (2) *slow*, 0.063 to 0.2 inch per hour; (3) *moderately slow*, 0.2 to 0.63 inch per hour; (4) *moderate*, 0.63 to 2.0 inches per hour; (5) *moderately rapid*, 2.0 to 6.3 inches per hour; (6) *rapid*, 6.3 to 12.0 inches per hour; and (7) *very rapid*, more than 12.0 inches per hour.

pH. See Reaction.

Profile, soil. A vertical section of soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, because it is neither acid nor alkaline. In words the degrees of acidity or alkalinity are expressed thus:

pH		pH	
Extremely acid---	Below 4.5.	Moderately	
Very strongly acid_	4.5 to 5.0.	alkaline	----- 7.9 to 8.4.
Strongly acid-----	5.1 to 5.5.	Strongly alkaline--	8.5 to 9.0.
Medium acid-----	5.6 to 6.0.	Very strongly	
Slightly acid-----	6.1 to 6.5.	alkaline	----- 9.1 and
Neutral	----- 6.6 to 7.3.		higher
Mildly alkaline----	7.4 to 7.8.		

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 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.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

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-like characteristics 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. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or R horizon.

Surface runoff. Rainwater that flows over the surface of the soil without sinking in; or the total volume of surface flow during a specified time.

Surface soil. The soil ordinarily moved in tillage or its equivalent in uncultivated soil, about 5 to 10 inches in thickness.

Terrace, river. A nearly level or undulating plain, commonly rather long and narrow and having a steep front that faces a river bottom.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Valley train. Outwash material deposited along stream valleys by aggrading streams of melt water pouring from glaciers.

Variant soil. A soil having properties sufficiently different from other known soils to justify a new series name but occupying a geographic area so limited that creation of a new series is not believed to be justified.

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.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Estimated yields, table 1, p. 12.
 Engineering uses of the soils, tables
 3, 4, and 5, pp. 16 through 37.

Estimated degree and kind of limitation for
 selected rural-fringe uses, table 6, p. 38.
 Acreage and extent, table 7, p. 51.

Map symbol	Mapping unit	Described on page	Capability unit	
			Symbol	Page
BbA	Birkbeck silt loam, 0 to 2 percent slopes-----	53	I-1	8
Bn	Bonpas silt loam-----	53	IIw-4	9
Bo	Bonpas silty clay loam-----	53	IIw-4	9
BrA	Brookston silt loam, 0 to 2 percent slopes-----	54	IIw-4	9
BsA	Brookston silty clay loam, 0 to 2 percent slopes-----	54	IIw-4	9
CaE2	Casco, Rodman, and Fox soils, 18 to 25 percent slopes, moderately eroded-----	55	VIIIs-1	11
CaF2	Casco, Rodman, and Fox soils, 25 to 50 percent slopes, moderately eroded-----	55	VIIIs-1	11
CaF3	Casco, Rodman, and Fox soils, 25 to 50 percent slopes, severely eroded-----	55	VIIIs-1	11
CbB	Celina bouldery silt loam, 2 to 6 percent slopes-----	55	IIe-1	8
CeA	Celina silt loam, 0 to 2 percent slopes-----	55	I-1	8
CeB	Celina silt loam, 2 to 6 percent slopes-----	56	IIe-1	8
CeB2	Celina silt loam, 2 to 6 percent slopes, moderately eroded-----	56	IIe-1	8
CmC2	Celina-Miami silt loams, 6 to 12 percent slopes, moderately eroded---	56	IIIe-1	9
CnE2	Channahon and Fairmount soils, 18 to 25 percent slopes, moderately eroded-----	56	VIe-1	11
CoA	Corwin silt loam, 0 to 2 percent slopes-----	57	I-1	8
CoB	Corwin silt loam, 2 to 6 percent slopes-----	57	IIe-1	8
Cr	Crane silt loam-----	58	IIw-2	8
CsA	Crosby bouldery silt loam, 0 to 2 percent slopes-----	58	IIw-2	8
CsB	Crosby bouldery silt loam, 2 to 6 percent slopes-----	58	IIw-2	8
CtA	Crosby silt loam, 0 to 2 percent slopes-----	58	IIw-2	8
CyB	Crosby-Celina silt loams, 2 to 6 percent slopes-----	59	IIw-2	8
DaA	Dana silt loam, 0 to 2 percent slopes-----	59	I-1	8
DaB	Dana silt loam, 2 to 6 percent slopes-----	59	IIe-1	8
FaF2	Fairmount soils, 25 to 50 percent slopes, moderately eroded-----	60	VIe-1	11
FcA	Fincastle silt loam, 0 to 2 percent slopes-----	61	IIw-2	8
FcB	Fincastle silt loam, 2 to 6 percent slopes-----	61	IIw-2	8
FgA	Fox gravelly loam, 0 to 2 percent slopes-----	62	IIs-1	9
FgB	Fox gravelly loam, 2 to 6 percent slopes-----	62	IIe-2	8
FgB2	Fox gravelly loam, 2 to 6 percent slopes, moderately eroded-----	62	IIe-2	8
FgC2	Fox gravelly loam, 6 to 12 percent slopes, moderately eroded-----	62	IIIe-2	9
F1A	Fox loam, 0 to 2 percent slopes-----	62	IIs-1	9
F1B	Fox loam, 2 to 6 percent slopes-----	62	IIe-2	8
F1B2	Fox loam, 2 to 6 percent slopes, moderately eroded-----	62	IIe-2	8
F1C2	Fox loam, 6 to 12 percent slopes, moderately eroded-----	62	IIIe-2	9
FmA	Fox silt loam, 0 to 2 percent slopes-----	62	IIs-1	9
FmB	Fox silt loam, 2 to 6 percent slopes-----	62	IIe-2	8
FmB2	Fox silt loam, 2 to 6 percent slopes, moderately eroded-----	62	IIe-2	8
FmC2	Fox silt loam, 6 to 12 percent slopes, moderately eroded-----	63	IIIe-2	9
FmD2	Fox silt loam, 12 to 18 percent slopes, moderately eroded-----	63	IVe-1	10
FsC3	Fox soils, 6 to 12 percent slopes, severely eroded-----	63	IVe-2	10
FsD3	Fox soils, 12 to 18 percent slopes, severely eroded-----	63	VIe-1	11
Gp	Gravel pits-----	63	VIIIs-1	11
GuC	Gullied land, rolling-----	63	VIIe-1	11
GuD	Gullied land, hilly-----	63	VIIe-1	11
GuF	Gullied land, steep-----	63	VIIe-1	11
La	Landes gravelly sandy loam-----	65	IIw-3	9

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit	
			Symbol	Page
Ld	Landes sandy loam-----	65	IIw-3	9
Lg	Landes sandy loam, gravelly subsoil variant-----	65	IIIIs-1	10
LsB	Lewisburg silt loam, 2 to 6 percent slopes-----	66	IIE-1	8
LsB2	Lewisburg silt loam, 2 to 6 percent slopes, moderately eroded-----	66	IIE-1	8
LtC3	Lewisburg soils, 6 to 12 percent slopes, severely eroded-----	66	IVE-2	10
Mb	Made land and Borrow pits-----	66	VIIIIs-1	11
Md	Medway silt loam-----	67	IIw-3	9
MeC2	Miami bouldery silt loam, 6 to 12 percent slopes, moderately eroded---	68	IIIe-1	9
MlC	Miami silt loam, 6 to 12 percent slopes-----	68	IIIe-1	9
MlC2	Miami silt loam, 6 to 12 percent slopes, moderately eroded-----	68	IIIe-1	9
MlD	Miami silt loam, 12 to 18 percent slopes-----	68	IVe-1	10
MlD2	Miami silt loam, 12 to 18 percent slopes, moderately eroded-----	68	IVe-1	10
MmC3	Miami soils, 6 to 12 percent slopes, severely eroded-----	69	IVe-2	10
MmD3	Miami soils, 12 to 18 percent slopes, severely eroded-----	69	VIe-1	11
MnB	Miami-Celina bouldery silt loams, 2 to 6 percent slopes-----	69	IIE-1	8
MnB2	Miami-Celina bouldery silt loams, 2 to 6 percent slopes, moderately eroded-----	69	IIE-1	8
MoB	Miami-Celina silt loams, 2 to 6 percent slopes-----	69	IIE-1	8
MoB2	Miami-Celina silt loams, 2 to 6 percent slopes, moderately eroded----	69	IIE-1	8
MpB3	Miami-Celina soils, 2 to 6 percent slopes, severely eroded-----	69	IIIe-3	9
MrE2	Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, moderately eroded-----	69	VIe-1	11
MrE3	Miami, Fox, and Hennepin soils, 18 to 25 percent slopes, severely eroded-----	69	VIe-1	11
MrF2	Miami, Fox, and Hennepin soils, 25 to 50 percent slopes, moderately eroded-----	70	VIIe-1	11
MrF3	Miami, Fox, and Hennepin soils, 25 to 50 percent slopes, severely eroded-----	70	VIIe-1	11
MsA	Millsdale silt loam, 0 to 3 percent slopes-----	70	IIIw-1	10
MtA	Millsdale silty clay loam, 0 to 3 percent slopes-----	71	IIIw-1	10
MuA	Milton silt loam, 0 to 2 percent slopes-----	71	IIIs-1	9
MuB	Milton silt loam, 2 to 6 percent slopes-----	71	IIE-1	8
MuB2	Milton silt loam, 2 to 6 percent slopes, moderately eroded-----	71	IIE-1	8
MuC2	Milton silt loam, 6 to 12 percent slopes, moderately eroded-----	71	IIIe-1	9
MvC3	Milton soils, 6 to 12 percent slopes, severely eroded-----	71	IVe-2	10
OcA	Ockley silt loam, 0 to 2 percent slopes-----	72	I-1	8
OcB	Ockley silt loam, 2 to 6 percent slopes-----	72	IIE-1	8
OkA	Ockley and Kendallville silt loams, 0 to 2 percent slopes-----	72	I-1	8
OkB	Ockley and Kendallville silt loams, 2 to 6 percent slopes-----	72	IIE-1	8
OkB2	Ockley and Kendallville silt loams, 2 to 6 percent slopes, moderately eroded-----	72	IIE-1	8
OkC2	Ockley and Kendallville silt loams, 6 to 12 percent slopes, moderately eroded-----	72	IIIe-1	9
OkD2	Ockley and Kendallville silt loams, 12 to 18 percent slopes, moderately eroded-----	72	IVe-1	10
O1C3	Ockley and Kendallville soils, 6 to 12 percent slopes, severely eroded-----	73	IVe-2	10
O1D3	Ockley and Kendallville soils, 12 to 18 percent slopes, severely eroded-----	73	VIe-1	11

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit	
			Symbol	Page
OsB	Odell silt loam, 2 to 6 percent slopes-----	73	IIw-2	8
PlB	Plattville silt loam, 2 to 6 percent slopes-----	74	IIe-1	8
PyA	Pyrmont silt loam, 0 to 2 percent slopes-----	74	IIw-2	8
PyB	Pyrmont silt loam, 2 to 6 percent slopes-----	75	IIw-2	8
Qu	Quarries-----	75	VIIIIs-1	11
Ra	Ragsdale silt loam-----	75	IIw-4	9
RcA	Randolph silt loam, 0 to 2 percent slopes-----	76	IIIw-1	10
RcB	Randolph silt loam, 2 to 6 percent slopes-----	76	IIIw-1	10
RdA	Raub and Dana silt loams, 0 to 2 percent slopes:	77		
	Raub soil-----	--	IIw-2	8
	Dana soil-----	--	I-1	8
ReA	Reesville silt loam, 0 to 2 percent slopes-----	78	IIw-2	8
RhB2	Ritchey and Channahon silt loams, 2 to 6 percent slopes, moderately eroded-----	78	IVe-2	10
RhC2	Ritchey and Channahon silt loams, 6 to 12 percent slopes, moderately eroded-----	79	IVe-2	10
RhD2	Ritchey and Channahon silt loams, 12 to 18 percent slopes, moderately eroded-----	79	VIe-1	11
RnC3	Ritchey and Channahon soils, 6 to 12 percent slopes, severely eroded-----	79	VIIe-1	11
RnD3	Ritchey and Channahon soils, 12 to 18 percent slopes, severely eroded-----	79	VIIe-1	11
Ro	Riverwash-----	79	VIIIs-1	11
Rs	Ross loam-----	80	IIw-3	9
RuA	Russell silt loam, 0 to 2 percent slopes-----	81	I-1	8
RuB	Russell silt loam, 2 to 6 percent slopes-----	81	IIe-1	8
RuB2	Russell silt loam, 2 to 6 percent slopes, moderately eroded-----	81	IIe-1	8
RuC2	Russell silt loam, 6 to 12 percent slopes, moderately eroded-----	81	IIIe-1	9
RuD2	Russell silt loam, 12 to 18 percent slopes, moderately eroded-----	81	IVe-1	10
RvC3	Russell soils, 6 to 12 percent slopes, severely eroded-----	81	IVe-2	10
RvD3	Russell soils, 12 to 18 percent slopes, severely eroded-----	82	VIe-1	11
Sh	Shoals silt loam-----	82	IIw-1	8
SlA	Sleeth silt loam, 0 to 2 percent slopes-----	83	IIw-2	8
So	Sloan silt loam-----	83	IIIw-2	10
ThA	Thackery silt loam, 0 to 2 percent slopes-----	84	I-1	8
ThB	Thackery silt loam, 2 to 6 percent slopes-----	84	IIe-1	8
TpA	Tippecanoe silt loam, 0 to 2 percent slopes-----	85	I-1	8
TpB	Tippecanoe silt loam, 2 to 6 percent slopes-----	85	IIe-1	8
WaA	Warsaw silt loam, 0 to 2 percent slopes-----	86	IIIs-1	9
WeA	Wea silt loam, 0 to 2 percent slopes-----	86	I-1	8
Wn	Westland silt loam-----	87	IIw-4	9
Ws	Westland silty clay loam-----	87	IIw-4	9
WyB	Wynn silt loam, 2 to 6 percent slopes-----	88	IIe-1	8
WyB2	Wynn silt loam, 2 to 6 percent slopes, moderately eroded-----	88	IIe-1	8
WyC2	Wynn silt loam, 6 to 12 percent slopes, moderately eroded-----	88	IIIe-1	9
XeA	Xenia silt loam, 0 to 2 percent slopes-----	89	I-1	8
XeB	Xenia silt loam, 2 to 6 percent slopes-----	89	IIe-1	8
XeB2	Xenia silt loam, 2 to 6 percent slopes, moderately eroded-----	89	IIe-1	8

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