SOIL SURVEY

Putnam 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 November 1974

Major fieldwork for this soil survey was done in the period 1964–68. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service, the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Putnam Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

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

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

Foresters and others can refer to the section "Woodland."

Game managers, sportsmen, and others concerned with wildlife can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, streets and parking lots, and recreation areas in the section "Soils and Land Use Planning."

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

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

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

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SOIL SURVEY OF PUTNAM COUNTY, OHIO

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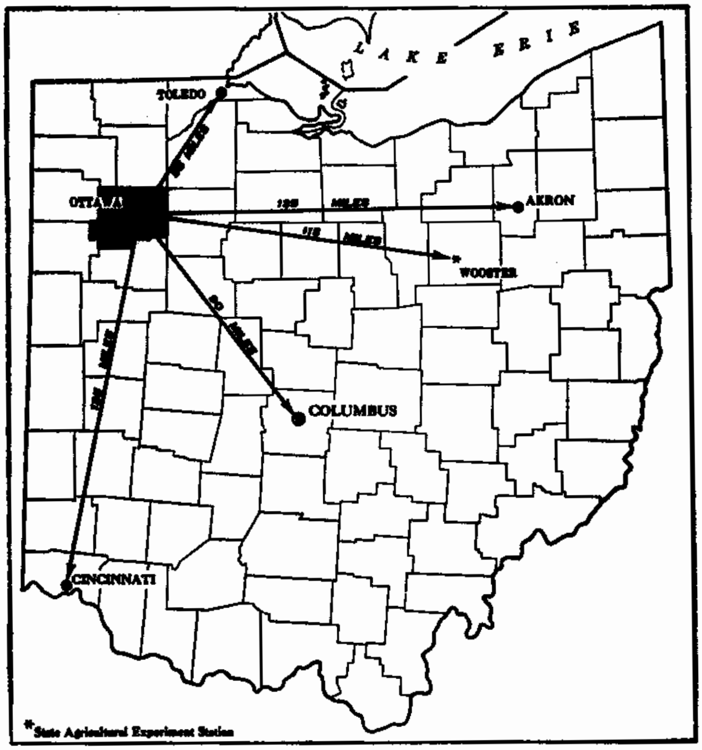

Figure 1.—Location of Putnam County in Ohio.

PUTNAM COUNTY is in the northwestern part of Ohio (fig. 1). It has a total land area of 311,040 acres, or about 486 square miles. Ottawa is the county seat and largest community. In 1970 the population of the county was 31,134.

This county has large areas of deep, dark-colored, nearly level, fertile soils that are well suited to cash-grain crops. Each year a large acreage is used for corn and soybeans. Only about 6 percent of the county is wooded.

In most of the county, the soils formed in water-worked till, in lacustrine sediment, and in deposits on old beach ridges. These areas were covered by lake water shortly after the glacier retreated and are now part of the Lake Plain in the northwestern part of Ohio. An area in the southeastern part of the county is a glacial till plain and was mostly above the level of the lake water.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Putnam County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of 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 the action of plant roots.

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

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. Blount and Paulding, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Blount loam, 0 to 2 percent slopes, is one of several phases within the Blount series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit is shown on the soil map of Putnam County—the soil complex.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Blount-Del Rey silt loams, 1 to 6 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Urban land is a land type in this county.

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

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil; and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They 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 current methods of use and management.

General Soil Map

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

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

Soil associations and delineations on the general soil map in this soil survey do not fully agree with those of the general soil map in adjacent counties published at a different date. Differences in maps are mainly the result of differences in the patterns of major soils in the adjacent counties.

These soil associations in this survey have been grouped into five general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 1, the words, ". . . clays and . . . silt loams and silty clay loams" refer to the texture of the surface layer.

Soils of the Lake Plain

The associations in this group are in broad areas below the elevation of the postglacial stages of Lake Erie. The soils generally are nearly level, and most of them are clayey or very clayey and very poorly drained. They are artificially drained and are intensively farmed, generally for cash grain. Six of the associations in Putnam County are in this group. They occupy about 78 percent of the county.

1. Paulding-Roselms association

Very poorly drained clays and somewhat poorly drained silt loams and silty clay loams; formed in lacustrine sediments

This association occupies much of the northwestern and west-central parts of the county. The soils generally are nearly level. In a few areas, gently sloping soils are on slight rises of this generally flat plain, but these areas are small and widely scattered. In places sloping soils are on valley sides adjacent to streams. This association occupies about 26 percent of the county.

Paulding soils make up about 80 percent of this association, Roselms soils 16 percent, and minor soils the remaining 4 percent.

Paulding soils are clayey and very poorly drained. They lie on broad flats of the Lake Plain. They commonly are saturated with water in winter and in spring and are subject to ponding.

Roselms soils are lighter colored than Paulding soils, are nearly level to gently sloping, and are on slight rises. They are saturated with water in winter and in spring, but they generally are not subject to ponding.

The minor soils are Broughton, Haskins, Mermill, Digby, and other similar soils. The most extensive of these are the moderately well drained, gently sloping to steep Broughton soils that commonly are on valley sides adjacent to streams.

This association is used primarily for grain farming. Very little of it is used for woodland or pasture. Wetness is the major concern in management. Although tile drainage is widely used, the Paulding and Roselms soils cannot be drained well by it, because they are clayey, structure is poorly developed, and permeability is very slow. A system of surface drains designed to supplement the tile drains is beneficial in removing surface water from the Paulding soils. Keeping the Paulding soils in good tilth generally is difficult because their clayey surface layer becomes cloddy if worked when wet or if worked often. Because of the very poor natural drainage, poor tilth, and slowness to dry out in spring, this soil commonly is worked when wet, and the limitation of poor tilth is intensified.

This association generally is planted to soybeans year after year because the soils do not dry out early enough to plant corn. Use of the Roselms and Broughton soils is limited by surface crusting in many places.

Limitations to many nonfarm uses of the dominant soils are very slow permeability and a seasonal high water table.

2. *Hoytville-Nappanee association*

Very poorly drained clays and silty clay loams and somewhat poorly drained silt loams and silty clay loams; formed in wave-modified glacial till

This association occupies much of the southern part of the county, except for Riley Township. It also is extensive in the northeastern part of the county. The soils generally are nearly level. In a few areas, gently sloping soils are on slight rises, but these areas are small and widely scattered. In a few places sloping soils are on valley sides adjacent to streams. This association occupies about 27 percent of the county.

Hoytville soils make up about 87 percent of this association, Nappanee soils 11 percent, and minor soils the remaining 2 percent.

Hoytville soils are nearly level, are very poorly drained, and occur on broad flats. They are deep and dark colored. They commonly are saturated with water in winter and in spring and are subject to ponding.

Nappanee soils are nearly level to gently sloping, are somewhat poorly drained, and occur on slight rises. They are saturated with water in winter and in spring, but generally they are not subject to ponding.

The minor soils are the St. Clair, Digby, Haskins, Mermill, and other similar loamy soils. St. Clair soils are the most extensive of these soils. They are moderately well drained and gently sloping to moderately steep, and they lie on valley sides adjacent to streams.

This association is used primarily for grain farming. Very little of it is used for woodland or for permanent pasture. Wetness is the major concern in management. Hoytville soils drain well with tile, but Nappanee soils do not. St. Clair soils do not need artificial drainage, but they are more subject to erosion than the major soils. On the Hoytville soils, a system of surface drains that supplements the tile drainage is beneficial because surface water commonly is excessive. Keeping favorable tilth is generally difficult on Hoytville soils, especially if the soils are worked when wet or worked too often. Nappanee and St. Clair soils commonly are subject to surface crusting.

Slow and very slow permeability and a seasonal high water table are limitations to many nonfarm uses of the Hoytville and Nappanee soils.

3. *Latty-Nappanee association*

Very poorly drained clays and somewhat poorly drained silt loams and silty clay loams; formed in lacustrine sediments and glacial till

This association is in transitional areas between the Hoytville-Nappanee association and the Paulding-Roselms association. The soils generally are nearly level. In a few areas gently sloping soils are on slight rises, but these areas are small and widely scattered. In places sloping soils are on valley sides adjacent to streams. This association occupies about 9 percent of the county.

Latty soils make up about 80 percent of the association, Nappanee soils 5 percent, and minor soils the remaining 15 percent.

Latty soils are nearly level, are very poorly drained, and occur on broad flats. They commonly are saturated with water in winter and in spring and are subject to ponding.

Nappanee soils are nearly level to gently sloping and are somewhat poorly drained. They lie on slight rises, and in many places they are surrounded by Latty soils. They are lighter colored than Latty soils. Nappanee soils are saturated with water in winter and in spring, but they generally are not subject to ponding.

The minor soils are the moderately well drained St. Clair soils on valley sides adjacent to streams, the somewhat poorly drained Haskins and Digby soils, the very poorly drained Mermill and Millgrove soils, and other similar loamy soils.

The association is used primarily for grain farming. Very little of it is used for woodland or for permanent pasture. Wetness is the major concern in management, and crops grown on the Latty and Nappanee soils show a moderate response to tiling. Even where the soils are properly drained, however, spring tillage is delayed in places because of wetness. Because of the ponding on Latty soils, a system of surface drains designed to supplement the tile drains is beneficial. St. Clair soils do not need artificial drainage. but they are more subject to erosion than the major soils in this association. Maintaining favorable tilth is generally difficult on Latty soils, especially if the soils are worked when wet. Nappanee and St. Clair soils commonly form a surface crust.

Limitations to many nonfarm uses of the dominant soils are very slow permeability and a seasonal high water table.

4. Hoytville-Haskins-Nappanee association

Very poorly drained clays and silty clay loams and somewhat poorly drained loams that formed in wave-modified glacial till, and somewhat poorly drained fine sandy loams and loams that formed partly in loamy material and partly in underlying lacustrine sediments or glacial till

This association is in a part of southern Sugar Creek and southern Pleasant Townships, north of State Route No. 12. This association occupies about 2 percent of the county.

Hoytville soils make about 50 percent of the association, Haskins soils 15 percent, Nappanee soils 10 percent, and minor soils the remaining 25 percent.

Hoytville soils are nearly level, deep, dark colored, and very poorly drained. They formed in water-worked glacial till. They commonly are saturated with water in winter and in spring and are subject to ponding. Hoytville soils have a high content of organic matter.

Haskins soils are nearly level to gently sloping and are somewhat poorly drained. They formed in 20 to 40 inches of loamy material that is underlain by clayey glacial till or lacustrine sediment. They lie in small areas on slight rises, knolls, and ridges that are numerous on the landscape. Haskins soils commonly are saturated with water in winter and in spring, but they are not subject to ponding. They have a low content of organic matter, and they are lighter colored than Hoytville soils.

Nappanee soils are nearly level to gently sloping, are somewhat poorly drained, and occur on slight rises. They formed in clayey till. Nappanee soils are commonly saturated with water in winter and in spring, but they are generally not subject to ponding. They have a low content of organic matter, and they are lighter colored than Hoytville soils.

The minor soils are the St. Clair, Mermill, Millgrove, Digby, Rimer, Seward and other similar loamy soils.

This association is used primarily for grain farming. Wetness is the major concern in management. Crops grown on Hoytville soils respond well to tile drainage. Crops on Haskins soils also respond well to tiling if the tiles are placed on or above the underlying clayey layer. Because of the surface-water difficulty on Hoytville soils, a system of surface drains to supplement the tile system is beneficial. When adequately drained, this association is well suited to most crops that are common to the area.

A seasonal high water table is a limitation to use of the dominant soils for many nonfarm purposes.

5. Toledo-Fulton association

Very poorly drained silty clay loams and silty clays and somewhat poorly drained loams and silty clay loams; formed in lacustrine sediments

This association is in areas that are mostly in the central part of the county, but several small areas are in the northern part of the county. The soils are nearly level to gently sloping. This association occupies about 8 percent of the county.

Toledo soils make up about 63 percent of the association, Fulton soils 31 percent, and minor soils the remaining 6 percent.

Toledo soils are nearly level. They occur on flats and near some of the narrow drainageways. These soils are deep, dark colored, and very poorly drained. They commonly are saturated with water in winter and in spring. In addition, they are subject to ponding. Toledo soils have a moderately high content of organic matter.

Fulton soils are nearly level to gently sloping, and they occur on slight rises. Like Toledo soils, they commonly are saturated with water in winter and in spring, but they generally are not subject to ponding.

The minor soils are the Lucas, Willette, Mermill, Millgrove, and other similar soils. Lucas soils, the most extensive, are moderately well drained, and they occur on gently sloping to moderately steep valley sides adjacent to streams. Also in this association is an area of Willette muck that is south of Miller City near the headwaters of South Powell Creek. This area occurs as one continuous level depression, and the muck is underlain by lacustrine clay. Willette soils are black and very poorly drained, and they commonly are ponded in wet weather. Adequate drainage is difficult to establish because of the difficulty in providing a suitable tile outlet. This soil is also subject to burning and soil blowing. If the soil is adequately drained, it is highly productive. Although this Willette soil has been used for truck farming in the past, it is now used for cash-grain farming common to the area.

Grain farming is the dominant type of farm management. Little of the acreage is managed for woodland or for permanent pasture. Wetness is the major concern in management. Crops grown on Toledo soils respond moderately well to tile drainage. Crops on Fulton soils respond less well to tile drainage. Because of the surface water on Toledo soils, a system of surface drains to supplement the tile drainage system is beneficial. Lucas soils do not need artificial drainage, but they are subject to the hazard of erosion. If Toledo soils are worked when wet, the maintenance of favorable tilth is a concern. Fulton and Lucas soils commonly form a surface crust.

Limitations to many nonfarm uses of the dominant soils are slow permeability and a seasonal high water table.

6. Lenawee-Del Rey association

Very poorly drained silt loams and silty clay loams and somewhat poorly drained loams and silt loams; formed in stratified lacustrine sediments

This association is in much of the southern half of Blanchard Township and in the part of Riley Township that is north of State Route No. 12. The soils are nearly level to gently sloping. This association occupies about 6 percent of the county.

Lenawee soils make up about 62 percent of the association, Del Rey soils 25 percent, and minor soils the remaining 13 percent.

Lenawee soils are nearly level and are on flats and near some of the drainageways. They are deep, dark colored, and very poorly drained. These soils commonly are saturated with water in winter and in spring. They also are subject to ponding. The content of organic matter is high in Lenawee soils.

Del Rey soils are nearly level to gently sloping. They occur on slight rises. These soils are saturated with water in winter and in spring, but they are not subject to ponding.

The minor soils are the moderately well drained, gently sloping to sloping Shinrock soils that occur on valley sides adjacent to streams, and the loamy Haskins, Mermill, Digby, Millgrove. and other similar soils.

This association is used primarily for cash-grain farming. Very little of it is managed for woodland or for permanent pasture. Wetness is the primary concern in management. Crops grown on Lenawee soils respond well to tile drainage, and on Del Rey soils they respond less well. Because the surface water ponds on Lenawee soils, a system of surface drains to supplement the tile drains is beneficial. Shinrock soils do not need artificial drainage, however, they are more subject to the hazard of erosion than the Lenawee or Del Rey soils. Maintaining favorable tilth on Lenawee soils is generally not difficult, but it can become difficult if the soils are worked when wet. Del Rey soils commonly form a crust. Although grain farming is dominant in this association, much of the acreage is used for the specialized crops of sugar beets, tomatoes, potatoes, and other similar vegetables.

Limitations to many nonfarm uses of the dominant soils are moderately slow to slow permeability and a seasonal high water table.

Soils of the Defiance Moraine

The association in this group is in a somewhat elevated area below the postglacial stages of Lake Erie. The landscape generally is hummocky and has many small depressions. The soils occur in intricate patterns. Most of the soils are clayey and somewhat poorly drained. They are artificially drained and are intensively farmed, generally for cash grain. The two associations in this group occupy about 5 percent of the county.

7. Del Rey-Fulton-Toledo association

Somewhat poorly drained silt loams and very poorly drained silty clay loams and silty clays; formed mainly in lacustrine sediments

This association is in a somewhat elevated area in the eastern part of the county. The most extensive soils are nearly level to gently sloping and are intermingled in intricate patterns on the landscape. Somewhat less extensive nearly level soils are in numerous small depressions, many of which are ponded in wet seasons. This association occupies about 3 percent of the county.

Del Rey and Fulton soils are in a complex that makes up about 50 percent of the association, Toledo soils 40 percent, and minor soils the remaining 10 percent.

Del Rey and Fulton soils are nearly level to gently sloping and are somewhat poorly drained. They are lighter colored than the nearby Toledo soils. Del Rey and Fulton soils commonly are saturated with water in winter and in spring, but they generally are not subject to ponding. The content of organic matter is low in these soils.

The nearly level Toledo soils are in depressions that are flanked by the Del Rey and Fulton soils at adjacent higher positions. Toledo soils are dark colored and are very poorly drained. In addition, they are subject to severe ponding, The content of organic matter is high in Toledo soils.

The minor soils are the somewhat poorly drained Haskins soils and the moderately well drained Tuscola, Shinrock, Haney, and Rawson soils.

Although this association is managed primarily for grain farming, a considerable amount of acreage is planted to tomatoes, sugar beets, and cucumbers. Wetness is the major concern in management. Toledo soils are suited to tile drainage, but in this association tile drains are not easily installed, because of the complicated soil pattern and the numerous depressions that are highly susceptible to ponding and in which tile must be placed deeply. Land leveling is frequently desirable; nevertheless, it may only provide limited benefit. The Del Rey and Fulton soils have a clayey subsoil below the plow layer, and if these soils are scalped to fill in the lower lying Toledo soils, the heavier, less desirable subsoil is exposed for farming. Favorable tilth is difficult to maintain in Toledo soils, especially if they are worked when wet.

A seasonal high water table in the dominant soils is a limitation to many nonfarm uses.

8. Kibbie-Del Rey-Toledo association

Somewhat poorly drained silt loams and very poorly drained silty clay loams and silty clays; formed in stratified lacustrine sediments

This association is in a hummocky, somewhat elevated area in the eastern part of the county. The most extensive soils are nearly level to gently sloping and are intermingled in intricate patterns on the landscape. Somewhat less extensive soils are nearly level and are in numerous small depressions that are ponded in most places in wet seasons. This association occupies about 2 percent of the county.

Kibbie and Del Rey soils make up about 53 percent of the association, Toledo soils 30 percent, and minor soils the remaining 17 percent.

The Kibbie and Del Rey soils are nearly level to gently sloping and are closely intermingled in intricate patterns. They are somewhat poorly drained and they are lighter colored than the nearby Toledo soils. The Kibbie and Del Rey soils commonly are saturated with water in winter and spring, but they generally are not subject to ponding. They have a low content of organic matter.

Toledo soils are nearly level and are in low, depressional areas that are flanked by the Kibbie and Del Rey soils in adjacent higher areas. Toledo soils are dark colored and are very poorly drained. They are subject to severe ponding. Toledo soils have a high content of organic matter.

The minor soils are the Tuscola, Shinrock, Haskins, Digby, Ottokee, and other similar soils. The most extensive are the moderately well drained Tuscola and Shinrock soils that occur on gently sloping rises and knolls.

This association is managed primarily for grain farming, but a considerable amount of acreage is planted to tomatoes, sugar beets, and cucumbers. Wetness is the major concern in management. Toledo soils are suited to tile drainage, but their suitability is markedly reduced because of the complicated pattern of the soils and the relief in this association. Adequate tile drainage requires a great amount of deep cutting; therefore, it is very difficult to attain both depth and grade on tile lines. There are also numerous sinkholes that are highly susceptible to ponding. Although land leveling commonly is desirable, it is difficult to put into practice because of the relief. The sizable cuts required expose the less desirable subsoil for farming.

A seasonal high water table is a limitation to many nonfarm uses of the dominant soils.

Soils of the Till Plain

The one association in this group is in the southeastern part of the county. The soils are mainly nearly level to gently sloping. They have a clayey subsoil and are very poorly drained and somewhat poorly drained. They generally are artificially drained, and they are intensively farmed, mainly for cash grain. The association in this group occupies about 3 percent of the county.

9. Pewamo-Blount association

Very poorly drained silty clay loams and somewhat poorly drained loams and silt loams; formed in glacial till

In this association are mainly nearly level to gently sloping soils on till plains in the extreme southeastern part of the county, generally south of State Route No. 12. This association occupies about 3 percent of the county.

Pewamo soils make up about 75 percent of the association, Blount soils 20 percent, and minor soils the remaining 5 percent.

Pewamo soils are nearly level and are on flats and in narrow drainageways. They are deep, dark colored, and very poorly drained. Pewamo soils commonly are saturated with water in winter and in spring and are subject to ponding. They have a high content of organic matter.

Blount soils are nearly level to gently sloping and are on slight rises. They are lighter colored than the Pewamo soils. Blount soils also are commonly saturated with water in winter and in spring, but generally they are not subject to ponding. The minor soils are mainly the moderately well drained, gently sloping Morley soils on the sides of valleys adjacent to streams, the somewhat poorly drained Haskins soils, and the very poorly drained Mermill soils.

This association is used primarily for grain farming. Very little of it is used for woodland or for permanent pasture. Wetness is the major concern in management. Crops grown on Pewamo soils respond well to tile drainage. Blount soils are less permeable and require more intensive drainage practices than Pewamo soils. Morley soils do not need artificial drainage, but they are more subject to the hazard of erosion. The maintenance of favorable tilth is a concern on Pewamo soils if they are worked when wet. Blount and Morley soils commonly form a surface crust.

Slow to very slow permeability and a seasonal high water table are limitations to use of the dominant soils for many nonfarm purposes.

Soils of the Beach Ridges and Stream Terraces

The one association in this group is on slight rises, ridges, and knolls throughout much of the county. The soils are loamy, are nearly level to gently sloping, and most of them are somewhat poorly drained or very poorly drained. They are artificially drained and are intensively farmed. These soils generally are more easily cultivated and more easily kept in good tilth than most of the other soils in the county. The association in this group occupies about 10 percent of the county.

10. Haskins-Mermill-Millgrove association

Somewhat poorly drained fine sandy loams and loams and very poorly drained loams and silty clay loams; mainly formed partly in loamy material and partly in underlying glacial till or lacustrine sediments

This association has many different kinds of soil, and it is on ridges and stream terraces. It occupies about 10 percent of the county.

Haskins soils make up about 30 percent of the association, Mermill soils 18 percent, Millgrove soils 16 percent, and minor soils the remaining 36 percent.

Haskins soils are nearly level to gently sloping, are somewhat poorly drained, and occur on slight rises, ridges, and knolls. They formed partly in loamy outwash material and partly in the underlying, clayey glacial till or lacustrine material. Haskins soils commonly are saturated with water in winter and in spring, but they generally are not subject to ponding. They have a low content of organic matter.

Mermill soils are nearly level, dark colored, and very poorly drained, and they occur in areas near the base of beach ridges. They formed partly in loamy outwash material and partly in the underlying clayey glacial till or lacustrine material. Mermill soils commonly are saturated with water in winter and in spring, and some of them are subject to ponding. Mermill soils have a high content of organic matter.

Millgrove soils are in positions similar to those of the Mermill soils. Like Mermill soils, they are dark colored and very poorly drained. They formed in loamy outwash material that overlies fine gravel and sand. Millgrove soils commonly are saturated with water in winter and in spring, and some areas are subject to ponding. They have a high content of organic matter.

The minor soils are the somewhat poorly drained Digby, Tedrow, and Rimer soils; the well-drained Belmore and Arkport soils; the moderately well drained Ottokee, Haney, Seward, Rawson, and Vaughnsville soils; and the very poorly drained Colwood and Wauseon soils.

Although this association is dominated by grain farming, many of the soils in it are well suited to special crops and truck farming. The Haskins, Mermill, Millgrove, Colwood, Digby, Rimer, Tedrow, and Wauseon soils need artificial drainage. They all are well suited to tiling. In addition, some surface drains are needed on the Mermill, Millgrove, Colwood, and Wauseon soils. The Belmore, Haney, Arkport, Ottokee, Seward, Rawson, and Vaughnsville soils do not need artificial drainage, and some of them tend to be droughty during the latter part of the growing season.

A seasonal high water table is a limitation to use of the dominant soils for many nonfarm purposes.

Soils of the Flood Plains

The associations in this group are in areas adjacent and parallel to the larger streams that flow through the county. The soils are loamy and clayey, and most of them are very poorly drained or somewhat poorly drained. Flooding is a hazard, and these soils generally are not farmed so intensively as the other soils in the county. Some areas of woodland and pasture are in these associations. The associations in this group occupy about 4 percent of the county.

11. Sloan-Shoals-Genesee association

Very poorly drained silty clay loams and somewhat poorly drained and well-drained silt loams; formed in stratified alluvium

In this association are nearly level soils on flood plains adjacent to streams. This association occupies about 3 percent of the county.

Sloan soils make up about 55 percent of the association, Shoals soils 20 percent, Genesee soils 15 percent, and minor soils the remaining 10 percent.

Sloan soils commonly are at the lower elevations on the flood plains. They are dark colored and are very poorly drained. Sloan soils are saturated with water in winter and in spring and are subject to flooding. They have a high content of organic matter.

Shoals soils are generally in slightly higher positions on the flood plains than Sloan soils. They are somewhat poorly drained and are lighter colored than Sloan soils. Shoals soils are saturated with water in winter and in spring and are subject to flooding. They have a moderately high content of organic matter.

Genesee soils occupy higher positions on the flood plains. Most of the areas of these soils are on flood plains along the Blanchard River. Genesee soils are well drained, and they are lighter colored than the Sloan soils.

The Eel, Haskins, Haney, and other similar soils occur to a small extent in this association.

Susceptibility to flooding is a limitation to use of these soils for farming, especially in winter and in spring. Consequently, winter and early spring crops generally are not grown in this association except in areas of Genesee soils that are less susceptible to flooding than are the Shoals and Sloan soils. Genesee soils do not require artificial drainage. Wetness is a concern on the Sloan and Shoals soils and artificial drainage is needed, but adequate tile outlets are difficult to establish in many places because of insufficient elevation above nearby streams. The soils in this association are well suited to corn, soybeans, and meadow crops.

Susceptibility to flooding is a severe limitation to use of these soils for most nonfarm purposes.

12. Wabasha-Defiance association

Very poorly drained silty clays and somewhat poorly drained silty clay loams; formed in stratified alluvium

In this association are nearly level soils on flood plains adjacent to the Little Auglaize River, Jennings Creek, North and South Powell Creeks, and their tributaries. This association occupies about 1 percent of the county.

Wabasha soils make up about 72 percent of the association, Defiance soils 12 percent, and minor soils the remaining 16 percent.

Wabasha soils are dark colored, have a high content of organic matter, and are very poorly drained. They commonly are saturated with water in winter and spring.

Defiance soils are lighter colored than Wabasha soils and are not so high in natural fertility as those soils. They are somewhat poorly drained and are saturated with water in winter and spring.

The minor soils are the Haskins, Haney, Kibbie, and other loamy soils in small areas.

Susceptibility to flooding is the major limitation to use of these soils for farming, especially in winter and in spring. Consequently, winter and early spring crops generally are not grown on these soils. Wetness also is a limitation, and artificial drainage is needed, but adequate tile outlets commonly are difficult to establish because the soils lack sufficient elevation above the nearby streams. Maintaining favorable tilth is a common difficulty on Wabasha soils and is more difficult if the soils are worked when wet.

Susceptibility to flooding is a severe limitation to most nonfarm uses of these soils.

Use and Management of Soils

This section describes two levels of soil management, explains the grouping of soils into capability units, and suggests use of the soils in the capability units for row crops, hay and pasture, and woodland. Also mentioned are crop yields, irrigation, and specialized crops. In addition, use of soils as woodland, for wildlife, and for engineering purposes is explained. This section ends with a discussion of the use of soils for town and country planning.

General Management for Farming

The soils in Putnam County differ widely in their use and management needs, but some management needs are common to all soils or to large groups of soils.

Two levels of management, improved and intensive, are defined in this management section, and estimated yields of the main crops are given for each of the two levels. In the capability unit descriptions, however, intensive management is stressed. Crops grown on most of the soils in the county generally respond well if the soils are intensively managed.

Capability grouping

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

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

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

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

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (None in Putnam 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 habitat.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat. (None in Putnam County.)
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or to esthetic purposes. (None in Putnam County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, but not in Putnam County, shows that the chief limitation is climate that is too cold or too dry.

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

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Wetness is the primary limitation to farming on about 95 percent of the total acreage in the county. Erosion is the primary limitation on about 4 percent of the acreage. Soils having few or no limitations to farming total only about 2,000 acres.

In the following pages the capability units in Putnam County are described, and suggestions for the use and management of the soils are given.

Management by capability units

The capability units used in Putnam County are described in the following pages. The miscellaneous land types are not assigned to a capability unit. The descriptions of the capability units give the general characteristics, properties, and qualities of the soils within the unit.

Soils in any one capability unit have about the same limitations and similar risks of damage and need, therefore, about the same kind of management. In some units, there may be one or two soils that have some properties or qualities different from the rest of the soils in the group. These exceptions are included in a capability unit because the soils have a low acreage, which does not justify a separate description, or they are similar in many respects to the other soils in the unit. If there is a significant difference for use or management, the exceptions are noted.

Reference in the descriptions to low, medium, or high available water capacity is related to the normal root depth of commonly grown field crops. The depth of the root zone refers to the depth of soil to a root-restricting layer, such as dense clay, compact till, highly calcareous material, or bedrock. The soil reaction noted is for natural conditions and denotes the most acid condition in the root zone. The reaction in a soil area may differ because of management.

These descripions note the dominant limitations of the soils for farm use. No specific recommendations for overcoming the limitations are given. Methods or combinations of practices that achieve erosion control or drainage are many in any given field of any kind of soil. For specific information regarding erosion control, artificial drainage, use of recommended crop varieties, or other management practices, the reader can contact the local Soil Conservation Service office or the Ohio Cooperative Extension Agent.

CAPABILITY UNIT I-1

Genesee silt loam is the only soil in this unit. This is a well-drained, nearly level soil on low-lying flood plains adjacent to major streams in the county. This soil is subject to flooding during major floods. The root zone is deep, permeability is moderate, and available water capacity is high.

Tile drainage normally is not required on this soil.

This soil is well suited to corn, soybeans, and other row crops. Floods early in spring may damage small grain. The soil is well suited to the specialty crops grown in the area, but measures to control flooding are needed in some places. Under intensive management, this soil can be used year after year for cultivated crops. It is well suited to irrigation.

The soil of this unit is well suited to adapted grasses and legumes grown for hay or pasture. Low areas that are subject to frequent flooding are better suited to permanent grass or trees than to cultivated crops.

CAPABILITY UNIT I-2

This unit consists of nearly level, moderately well drained soils that have a loam surface layer. These soils are in the Haney and Rawson series. The root zone is deep or moderately deep, permeability is moderate, and available water capacity is medium.

These soils have no features that limit their use for field crops and pasture. Erosion is not a hazard or is only a slight hazard where management is good. Deterioration of the soil structure can be prevented by growing crops that supply a large amount of residue.

All the field crops and hay or pasture plants commonly grown in the county can be grown on these soils. The soils also are suited to some specialty crops. Under intensive management, these soils can be used year after year for cultivated crops. The soils in this unit are well suited to irrigation.

CAPABILITY UNIT IIe-1

In this unit are nearly level to gently sloping, well drained and moderately well drained soils of the Belmore, Haney, Rawson, Shinrock, and Tuscola series. These soils are on stream terraces and beach ridges. They have a deep to moderately deep root zone, very slow to moderately rapid permeability, and medium to high available water capacity. A sandy and gravelly substratum underlies Belmore and Haney soils. The Rawson soils have a fine-textured substratum that restricts the downward movement of water.

A moderate hazard of erosion is the major limitation to use of these soils. Maintaining fertility, improving tilth, and providing an adequate supply of organic matter are necessary where these soils are cultivated.

These soils are suited to all row crops, small grain, hay crops, and pasture plants commonly grown in the county. They also are suited to fruit trees. If erosion is controlled, these soils are suited to irrigation.

CAPABILITY UNIT IIe-2

In this unit are well drained and moderately well drained sandy soils of the Arkport and Seward series. These nearly level to gently sloping soils are on beach ridges and low, sandy knolls. They have a moderately deep or deep root zone, moderately rapid to slow permeability, and low to medium available water capacity. The Arkport soils have a fine sand substratum. Seward soils have a fine-textured substratum that restricts the downward movement of water.

A moderate hazard of erosion is the major limitation to use of these soils. Droughtiness is also a hazard, and in spring soil blowing is a hazard in cultivated fields and in areas that lack plant cover. Maintaining fertility and the content of organic matter are management concerns where these soils are farmed.

The soils in this unit are suited to the row crops and pasture plants that commonly grow in the county. They are not well suited to specialty crops unless very intensive management is used. These soils are suited to irrigation.

CAPABILITY UNIT IIe-3

Shinrock silt loam, 2 to 6 percent slopes, is the only soil in this unit. This soil is gently sloping and moderately well drained. It has a silt loam surface layer, moderately slow permeability, medium available water capacity, and a moderately deep root zone. This soil has rapid runoff and is subject to erosion. Generally, the slopes are short, and the application of erosion-control measures is difficult.

This soil is suited to most field crops grown in the county. It can be cultivated frequently if erosion is controlled and if the surface layer is kept in good tilth. Artificial drainage generally is not required on this soil, but some areas are tiled because they are adjacent to less well-drained soils. This soil is also suited to permanent pasture, and pasture plants grow fairly well to well. Legume-grass meadows grow well.

CAPABILITY UNIT IIw-1

In this unit are nearly level and somewhat poorly drained soils of the Shoals series and the Shoals series, moderately shallow variant. These soils occupy low-lying positions on flood plains that border the major streams in the county and are subject to flooding. The root zone is deep to moderately deep, and these soils are moderately permeable. The Shoals variant is underlain by bedrock at a depth of 20 to 40 inches. Available water capacity generally is high, except for the Shoals variant, where it is medium.

Wetness is a moderate limitation to use of these soils. This limitation results from a seasonal high water table, occasional flooding, and runoff from adjacent slopes. The seasonal high water table can be lowered by use of tile drains if suitable outlets are available. Tile drains are difficult to install in areas of the Shoals variant. Surface wetness and ponding can be reduced by shallow ditches and by diversions at the base of adjacent slopes. If these soils are worked or pastured when wet, the resulting compaction and deterioration of structure make the soils more difficult to till and the pastures less productive.

Drained areas of these soils are well suited to corn, soybeans, and other row crops, but they are of limited use for small grain and certain hay crops because of susceptibility to flooding. Only hay and pasture plants that tolerate wetness are suitable. Areas that are frequently flooded need to be kept continuously under a protective cover of either trees or grass.

CAPABILITY UNIT IIw-2

This unit consists mostly of somewhat poorly drained soils of the Del Rey, Digby, Fulton, Haskins, Kibbie, and Vaughnsville series. These nearly level to gently sloping soils occur throughout the county. They have a seasonal high water table, and they stay wet until late spring unless drained by tile. These soils have a moderately deep to deep root zone, mostly moderate permeability, and medium to high available water capacity.

Wetness is the major limitation to use of these soils. Erosion is a hazard in long gently sloping areas. Maintenance of good tilth is a concern where the surface layer is silt loam, particularly if the soils are worked when wet. The resulting compaction and deterioration of tilth causes the concern. The seasonal high water table can be lowered by use of tile drains where drainage ditches provide adequate outlets.

The soils of this unit are well suited to all row crops, small grain, hay crops, and pasture plants commonly grown in the county. These soils can be continuously cultivated if intensive management is used. The soils also are suited to the specialty crops grown in the area.

CAPABILITY UNIT IIw-3

This unit consists of sandy, somewhat poorly drained soils of the Rimer and Tedrow series. These soils are nearly level to gently sloping. They have a moderately deep to deep root zone, rapid permeability, and low to medium available water capacity.

The major limitation of these soils is wetness. Soil blowing is a moderate concern if the soils are not protected by vegetation. The seasonal high water table can be lowered by use of tile drains; however, pump drainage may be necessary where ditch outlets are unsatisfactory. Placement of tile in the Rimer soils should be just into the underlying clay. Filters around the tile to prevent clogging from sand are needed in the Tedrow and Rimer soils.

The soils of this unit are well suited to all field crops commonly grown in the county. They can be row cropped fairly intensively where proper management is practiced. These soils should be protected by vegetation or stubble as much as possible to reduce soil blowing. Hay and pasture plants that tolerate wetness are suitable for seeding in undrained areas.

CAPABILITY UNIT IIw-4

In this unit are nearly level to gently sloping, somewhat poorly drained soils of the Blount and Del Rey series. These soils have a surface layer of loam or silt loam. They have a moderately deep to deep root zone, slow permeability, and medium to high available water capacity. They have a moderately fine textured and fine textured subsoil, and the content of organic matter is low in the upper part of the profile. As a result of slow permeability, a high water table is common in winter, early in spring, and in prolonged wet periods. Maintaining good tilth is a concern in management where the soils have a silt loam surface layer, because the content of organic matter generally is low. These soils commonly form a surface crust. Erosion is a hazard because of the slow permeability and the slopes, but seasonal wetness is the major limitation.

These soils are suited to most field crops grown in the county. If intensively managed they can be cultivated frequently. Less than intensive management is likely to result in poor tilth and poorer crops.

Artificial drainage is needed on these soils. Waterways and surface drains help to remove excess water from the surface without causing erosion. Hay and pasture plants that tolerate wetness should be seeded in undrained areas. These soils can be tile drained, but water movement in the subsoil is slow. In some areas surface ponding is a concern.

CAPABILITY UNIT IIw-5

In this unit are soils of the Colwood, Lenawee, Mermill, Millgrove, Pewamo, and Wauseon series. These soils are very poorly drained and nearly level. They have a moderately deep to deep root zone, moderate to very slow permeability, and high to medium available water capacity. The Millgrove soils are underlain by sand and gravel. Clayey materials occur under the Mermill and Wauseon soils.

Wetness is the major limitation to use of these soils. Maintenance of good tilth is a concern if these soils are worked while wet. The resulting compaction and deterioration of structure makes the soil more difficult to till. Generally, this damage to structure is more of a concern on the soils having a silt loam or silty clay loam surface layer. The seasonal high water table can be lowered by use of tile drains, where outlets can be provided. If possible, the placement of tile in the Mermill and Wauseon soils should be just into the underlying clay.

In drained areas, the soils of this unit are well suited to all row crops, small grain, hay crops, and pasture plants commonly grown in the county. They are also well suited to adapted specialty crops. If properly managed, these soils can be cropped intensively to row crops. The soils are suited to irrigation. Undrained areas of these soils are suited only to pasture and hay crops that can tolerate wetness for long periods.

CAPABILITY UNIT IIw-6

Hoytville clay and Hoytville silty clay loam are the only soils in this unit. These soils are on uplands in both the northern and southwestern parts of the county. They have the most extensive acreage of any of the soils in the county. These soils are very poorly drained and nearly level. They have a deep root zone, slow permeability, and high available water capacity.

Wetness is the major limitation to use of these soils. Maintenance of good tilth is also a concern if the soils are worked or pastured when wet. The compaction and deterioration of structure creates a soil tilth difficulty. This difficulty is less pronounced in the southwestern part of the county where the silty clay loam texture occurs. Excess soil water can be removed by tile drains. Drainage ditches provide outlets for the tile and for surface drains also.

These soils can be continuously cultivated under intensive management. If they are adequately drained, these soils are well suited to all crops commonly grown in the county. They also are suited to specialty crops grown in the area and to irrigation.

Drained areas of these soils are suited to most of the commonly grown pasture and hay crops, including alfalfa. Undrained areas are suited only to pasture and hay crops that can tolerate wetness for long periods.

CAPABILITY UNIT IIIe-1

In this unit are well drained and moderately well drained sloping soils of the Belmore and Rawson series. These soils have a moderately deep to deep root zone, moderately rapid to very slow permeability, and medium available water capacity.

A severe hazard of erosion is the major limitation to use of these soils for cultivated crops. Maintaining fertility and good tilth and providing an adequate supply of organic matter are management concerns where the soils are cultivated frequently. The moderately eroded Rawson soils have lost part of their surface layer, and the underlying material is mixed with the material of the remaining surface layer. Intensive management is essential on this Rawson soil because the surface layer is now more susceptible to erosion.

The soils in this unit are suited to the field crops and hay and pasture plants commonly grown in the area. The soils are not well suited to specialty crops unless very intensive management is used. The hazard of erosion can be minimized if crops are grown that provide a vegetative cover during most of the growing season. Controlled grazing minimizes the hazard of erosion in pasture areas.

CAPABILITY UNIT IIIe-2

This unit consists of moderately well drained, gently sloping soils of the Broughton, Lucas, Morley, St. Clair, and Shinrock series. These soils are mainly on side slopes adjacent to streams. A small acreage of the Shinrock soils is sloping. These soils have a moderately deep root zone, moderately slow to very slow permeability, and low to medium available water capacity. The Broughton and Shinrock soils are moderately eroded, and the present surface layer is a mixture of the material originally in the surface layer and that in the upper part of the subsoil. This resulted from cultivation and erosion.

The hazard of erosion is the major limitation on these soils. Maintaining soil structure and content of organic matter are concerns if these soils are cultivated. Generally, drainage is not needed; however, there may be wet spots from seeps during prolonged wet weather.

These soils are suited to the field crops and hay and pasture plants commonly grown in the county. They are not well suited to specialty crops. Intensive management limits the hazard of erosion where row crops are grown. Crops that provide a fairly complete cover during most of the growing season also minimize the hazard of erosion. If the areas are not overgrazed, an adequate cover of pasture plants helps to control erosion.

CAPABILITY UNIT IIIw-1

This unit consists of somewhat poorly drained, nearly level or gently sloping soils on knolls and ridges throughout the county. These soils are in the Fulton, Nappanee, and Roselms series. They have a seasonal high water table and stay wet until late in spring, unless they are artificially drained. These soils have very slow permeability, medium available water capacity, and a moderately deep root zone. Roselms soils are more clayey throughout their profile than are the other soils in this unit.

Wetness is the major limitation to use of these soils. Susceptibility to erosion also is a limitation where the soils are gently sloping. Maintenance of good tilth is difficult if these soils are tilled while they are wet. Soil tilth is a concern where the soil structure has been damaged, or the soils have been compacted. Crusts form in spring after planting, especially on soils that have a silty clay surface layer. The seasonal high water table can be lowered by use of tile drains, but the tile is only moderately effective in these clayey soils. Excess water can be safely removed by surface drains where the soils are nearly level.

Drained areas of these soils are suited to most of the commonly grown pasture and hay crops, including alfalfa. Undrained areas are suited only to pasture and hay crops that can tolerate wetness for long periods.

CAPABILITY UNIT IIIw-2

In this unit are very poorly drained and nearly level soils of the Bono, Latty, Paulding, and Toledo series. These soils have slow to very slow permeability, medium to high available water capacity, and a moderately deep to deep root zone. The Paulding soils are more clayey throughout than the other soils in the unit.

Wetness is the major limitation to use of these soils. The wetness results from a seasonal high water table and from the heavy clayey material that makes up the soils. Maintenance of good structure is difficult if the soils are frequently tilled or if they are pastured when wet. Poor tilth is a serious concern. Tile drains are not sufficiently effective in removing excess water from these soils. They are especially ineffective in the Paulding soil. Land smoothing along with surface drains control surface ponding, and if used with tile they provide about the most effective means of controlling excess water on these soils.

The soils of this unit are suited to row crops and small grain. They can be used for adapted specialty crops; however, the Toledo soils are better suited to this use than are the other soils. Corn does not grow well on Paulding soils.

Drained areas of these soils are suited to most of the commonly grown pasture and hay crops, including alfalfa. Undrained areas are suited only to pasture and hay crops that can tolerate wetness for long periods.

CAPABILITY UNIT IIIw-3

This unit consists of somewhat poorly drained to very poorly drained, nearly level soils on flood plains adjacent to streams. These are soils of the Defiance, Sloan, and Wabasha series and the Wabasha series, moderately shallow variant. They have moderate to slow permeability, high available water capacity, and a deep to moderately deep root zone. The Wabasha and Defiance soils are more clayey throughout than Sloan soils. The Wabasha variant is underlain by bedrock at a depth of 20 to 40 inches.

The major limitation of these soils is wetness that results from a seasonal high water table. Also, flooding is a hazard.

Tile and surface drains remove the excess water where adequate outlets can be provided. Runoff from adjacent slopes can be intercepted by diversions placed along the base of slopes. Maintaining soil structure is a concern if the soils are frequently worked or pastured when they are wet.

Where the soils in this unit are drained, they are suited to row crops, such as corn and soybeans. Winter grain generally is not grown because it is subject to damage by flooding in winter. These soils generally are well suited to pasture grasses and legumes that can tolerate wetness. Areas that are not easily drained or are frequently flooded should be kept in permanent pasture or trees.

CAPABILITY UNIT IIIw-4

Only Willette muck, an organic soil that is underlain by lacustrine clay material, is in this unit. This soil is very poorly drained and is level or nearly level. It has slow permeability in the substratum, medium to high available water capacity, and a moderately deep root zone. Because of its depressional position on the landscape, it receives runoff from adjacent areas. The seasonal water table is high, and outlets for drainage are difficult to obtain in some places. This soil is subject to soil blowing when the surface layer is dry, and it can burn. It is subject to subsidence when the water table is lowered. Deficiency of trace elements is common. Maintaining good tilth is not a management concern.

This soil is particularly adapted to row crops and specialty vegetable crops. Row crops can be grown year after year, but intensive management is needed to prevent damage to the soil. Weed control is a particular concern on this soil. Proper weed control is essential to the successful growth of some crops.

This soil needs artificial drainage that consists of both tile and open ditches. Lift pumps may be required because of the low-lying position of this soil. Water table levels need to be controlled to avoid excessive drying and subsidence.

Most of this soil is cultivated. This soil is not well suited to permanent pasture or hay crops.

CAPABILITY UNIT IIIs-1

This unit consists of nearly level or gently sloping soils of the Ottokee and Tuscola series. These soils are mainly on beach ridges and in the sandier sections of the county. They are moderately well drained. They have a deep root zone, rapid to moderate permeability, and low to high available water capacity. The Tuscola soils are more silty throughout the profile than are the Ottokee soils.

Droughtiness is the major limitation to use of these soils. Soil blowing is a hazard in cultivated and open fields. These soils have a low content of organic matter. Crop residue and green-manure crops can be worked into the soil to increase the organic-matter content.

The soils in this unit are suited to row crops and pasture plants commonly grown in the area. They also are suited to small grain that matures before extended periods of dryness. They are not well suited to specialty crops unless very intensive management is used. Hay crops do well if deep-rooted legumes are used in a legume-grass mixture. Crops lack adequate moisture during extended dry periods.

CAPABILITY UNIT IVe-1

In this unit are moderately well drained, sloping soils of the Broughton and St. Clair series. These soils are mainly in areas adjacent to the major streams in the county. They have a moderately deep root zone, very slow permeability, and medium to low available water capacity. The soils are moderately eroded, and their present surface layer is a mixture of the material originally in the surface layer and that in the upper part of the subsoil.

A severe hazard of erosion is the major limitation to use of these soils. Maintaining fertility, improving tilth, and providing an adequate supply of organic matter are concerns where the soils are tilled frequently. If the soils are worked or pastured when wet, serious compaction and deterioration of structure can result.

The soils in this unit are suited to most row crops, small grain, hay, and pasture crops commonly grown in the county. Crop growth is reduced, however, because of the erosion damage and unfavorable tilth. Keeping tillage to a minimum in the preparation of seedbeds helps to preserve soil structure. This practice also lessens surface crusting. Intensive management should include crops that provide good vegetative cover. Cultivated crops should be grown only infrequently. If these soils are used for hay and pasture, an adequate plant cover is needed to protect the areas.

CAPABILITY UNIT VIe-1

This unit consists of sloping to steep, moderately well drained soils that are mainly adjacent to the major streams in the county. These soils are in the Broughton, Lucas, and St. Clair series. They have a moderately deep root zone, very slow to slow permeability, and medium to low available water capacity. These soils are moderately eroded.

A severe hazard of erosion is the major limitation to use of these soils. These soils are suitable for legume-grass meadow or pasture. If the soils are pastured when wet, serious compaction and deterioration of structure can result. Pasture plants do not grow well in these compacted areas.

These soils are suited to all hay crops and pasture plants commonly grown in the county. They are not suited to row crops and specialty crops. Occasional reseeding to winter grain is satisfactory if tillage is kept to a minimum.

These soils are suited to trees. They can be used for woodland, and the trees provide protection for the watershed.

Estimated yields

Table 1 shows, for all soils in the county, the estimated yields per acre of the principal crops. The yields are the averages of those expected over a period of several years under two levels of management. Yields are not listed for the following soils and land types, because they are not suited to the crops: Broughton clay, 12 to 18 percent slopes, moderately eroded; Broughton clay, 18 to 25 percent slopes, severely eroded; Clay pits; Cut and fill land; Gravel pits; Quarries; and Urban land.

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

1. Practices are used that increase the intake of water and the water-holding capacity of the

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

For an improved level of management, the farmer uses some, but not all, of the practices listed under intensive management, or the practices he uses are not adequate for the needs of the crops.

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

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

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

Irrigation

Generally, Putnam County receives ample rainfall for crop moisture requirements, but intervals commonly occur when rainfall is less than optimum. During these dry periods supplemental irrigation of crops and pasture helps to increase crop and forage production.

The soils in Putnam County vary greatly in suitability for irrigation. The Ottokee, Tedrow, Seward, Rimer, and other sandy soils are very permeable but lack adequate available water holding capacity. Irrigation of these soils has to be more frequent than on loamy soils. From the standpoint of permeability and available water capacity, the soils that are best suited to irrigation include these in the Belmore, Haney, Digby, Kibbie, Colwood, Millgrove, Mermill, Rawson, Genesee, and Tuscola series. The Digby, Kibbie, Colwood, Millgrove, and Mermill soils need to be drained artificially before irrigation is attempted. The finer textured silty clay loam, clay, and silty clay soils, such as the Latty, Toledo, Nappanee, and Paulding are poorly suited to irrigation because permeability is slow. Additional information on irrigation of Putnam County soils is given under "Engineering Interpretations." Other useful information is available from the local Soil and Water Conservation District and the Ohio Cooperative Extension Agent. An adequate supply of water is necessary for irrigation. Use of surface water in streams and ponds is limited in places since it is controlled by the Ohio Department of Natural Resources, and the water rights of users downstream must be considered.

Use of Soils for Specialized Crops

Specialized crops grown for commercial use are mainly tomatoes and sugar beets that are grown under contracts to processing companies. Specific practices, fertilization rates, or seeding varieties are not given for these crops in this subsection. Such information can be obtained from the Ohio Cooperative Extension Agent, the Soil and Water Conservation District, or from field representatives of the commercial packing and processing companies.

Sugar beets.—This crop requires soils that have high available water capacity, relatively high content of organic matter, and soil reaction between 6.5 and 7.0 pH. Deep, dark-colored, medium-textured or moderately fine textured soils are better suited than others. Good soil tilth and aeration are important for producing sugar beets.

If adequately drained, the Hoytville, Lenawee, and Colwood soils are suited. Some beets are grown on Latty and Toledo soils, but limited soil aeration is a management concern on these soils. The dark-colored soils commonly used for beets are very poorly drained. Systems of surface and tile drainage have been developed that adequately control surface water and wetness.

Processing companies generally avoid contracting for sugar-beet production on sandy soils, such as Arkport, Ottokee, and Seward, because beets grown on sands form multiple tap roots and lack the beet shape suited to processing.

Tomatoes.—Tomatoes for commercial processing are an important crop in Putnam County. They can be grown on a wide range of soils, but they grow best on medium-textured to moderately fine textured, dark-colored soils that have a deep root zone, high available water capacity, and a high content of organic matter. Hoytville, Lenawee, and Toledo are some of the soils that meet the requirements.

The tomato plant roots deeply and is likely to be injured by an excess amount of water in the soil. It becomes more susceptible to injury from water as the plant approaches maturity. Surface flooding causes plant damage within hours. Consequently, good drainage, both surface and within the soil, is essential where this crop is grown. The dark-colored soils commonly used for tomatoes are very poorly drained. Surface and tile drainage have been developed to help control excessive surface water and soil moisture. This extensive drainage system provides good control of excess water and insures adequate soil aeration.

Vegetables.—A very small acreage of truck crops is grown in the county, and it includes crops such as sweet corn, cucumbers, and cabbage. Loamy soils that warm up early in spring are suited to these crops. Well-drained Belmore and moderately well drained Haney soils are examples. Moisture storage capacity is limited in these soils, but they are well suited to irrigation.

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

[Yields in columns A can be expected under the improved management now commonly used in the county; those in columns B can be expected under intensive management. Absence of a yield figure means that the crop commonly is not grown under the management level indicated or that the soil is not suited to the specified crop. Soils not commonly used for crops are not listed in the table]

Soil	Corn		Soybeans		Wheat		Oats		Hay		Tomatoes [1]	Sugar beets [2]
	A	B	A	B	A	B	A	B	A	B	B	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Arkport loamy fine sand, 2 to 6 percent slopes	60	84	18	25	27	41	40	65	2.1	3.4		
Belmore sandy loam, 2 to 6 percent slopes	60	88	19	25	28	37	45	67	2.4	3.7		
Belmore loam, 0 to 2 percent slopes	65	95	22	29	32	40	50	72	2.5	4.0		
Belmore loam, 2 to 6 percent slopes	60	90	22	28	31	39	48	68	2.4	3.8		
Belmore loam, 6 to 12 percent slopes					28	35	45	65	2.2	3.5		
Blount loam, 0 to 2 percent slopes	90	115	25	35	32	40	50	75	2.8	4.2	17.0	10.0
Blount silt loam, 0 to 2 percent slopes	90	115	26	40	34	42	52	80	3.0	4.5	17.0	10.5
Blount silt loam, 2 to 6 percent slopes	85	110	24	34	30	38	48	72	2.5	4.0	16.0	9.5
Blount-Del Rey silt loams, 1 to 6 percent slopes	80	105	26	36	30	38	50	70	2.5	4.0	17.0	10.0
Bono silty clay loam	88	122	31	42	32	44	63	82	3.0	4.6	26.0	19.7
Broughton silty clay loam, 2 to 6 percent slopes	35	52	15	20	21	28	35	55	1.7	3.0		
Broughton clay, 2 to 6 percent slopes, moderately eroded	30	45	14	18	20	26	32	52	1.7	3.0		
Broughton clay, 6 to 12 percent slopes, moderately eroded					20	25	35	55	1.5	2.5		
Colwood loam	95	120	30	40	35	50	70	85	3.0	5.0	29.7	23.2
Defiance silty clay loam [3]	65	95	25	35	25	35	50	65	2.5	4.0		
Del Rey loam, 0 to 2 percent slopes	80	105	30	42	32	44	55	75	2.7	4.4	18.5	12.0
Del Rey silt loam, 0 to 2 percent slopes	76	102	28	40	30	42	52	73	2.6	4.2	18.2	11.7
Del Rey silt loam, 2 to 6 percent slopes	75	100	28	38	28	40	50	70	2.5	4.1	17.9	11.4
Del Rey-Fulton silt loams, 1 to 6 percent slopes	70	95	25	33	27	38	47	68	2.3	4.0	17.7	10.7
Digby loam, 0 to 2 percent slopes	84	114	36	48	40	48	67	82	2.6	4.9	20.0	13.0
Digby loam, 2 to 6 percent slopes	80	108	32	38	36	46	64	78	2.4	4.6	19.0	12.5
Digby loam, moderately shallow variant, 0 to 2 percent slopes	60	85	25	30	35	45	60	75	2.2	4.4		
Fulton loam, 0 to 2 percent slopes	62	96	26	36	30	42	52	73	2.5	4.2	17.5	11.0
Fulton silty clay loam, 0 to 2 percent slopes	60	93	23	33	27	39	50	70	2.3	4.0	16.2	10.4
Fulton silty clay loam, 2 to 6 percent slopes	60	90	19	26	25	37	44	66	2.1	3.8	15.8	10.0
Fulton silty clay loam, gravelly substratum, 0 to 2 percent slopes	62	96	26	36	30	42	52	73	2.5	4.2	17.5	11.0
Genesee silt loam [3]	98	120	34	46	36	47	64	85	3.2	5.0	22.5	14.5
Haney sandy loam, 2 to 6 percent slopes	84	101	28	33	35	44	68	78	2.0	3.8	17.5	11.5
Haney loam, 0 to 2 percent slopes	88	108	32	38	38	48	72	82	2.4	4.4	19.0	13.0
Haney loam, 2 to 6 percent slopes	86	105	30	36	36	46	70	80	2.2	4.0	18.5	12.5
Haskins fine sandy loam, 0 to 2 percent slopes	76	105	32	44	34	46	60	85	2.2	4.0	19.0	12.0
Haskins fine sandy loam, 2 to 6 percent slopes	73	102	30	41	32	44	58	82	2.1	3.8	18.0	11.0
Haskins loam, 0 to 2 percent slopes	79	108	33	45	36	48	62	86	2.4	4.4	19.5	12.5
Haskins loam, 2 to 6 percent slopes	77	105	32	42	34	45	60	82	2.4	4.4	18.5	12.0
Hoytville silty clay loam	90	120	37	47	38	50	67	87	3.0	5.0	29.2	21.5
Hoytville clay	90	120	35	45	38	48	65	85	3.0	5.0	28.5	21.0
Kibbie loam, 0 to 2 percent slopes	87	109	35	45	35	46	63	84	2.6	4.5	19.8	12.3
Kibbie silt loam, 0 to 2 percent slopes	88	111	36	46	36	47	64	85	2.6	4.6	20.0	12.5
Kibbie-Del Rey silt loams, 1 to 6 percent slopes	82	105	32	42	32	44	58	78	2.5	4.4	19.0	12.0
Latty silty clay loam	92	120	34	44	35	48	60	82	2.8	4.8	24.8	19.2
Latty clay	90	118	32	42	33	45	55	78	2.8	4.7	24.5	19.0
Lenawee silt loam	102	130	36	47	38	50	67	87	3.0	5.0	29.2	21.5
Lenawee silty clay loam	100	130	35	45	36	48	65	85	3.0	5.0	28.5	21.0
Lucas silty clay loam, 2 to 6 percent slopes	60	90	19	29	25	35	46	74	2.0	3.6	14.0	9.3
Lucas silty clay loam, 6 to 12 percent slopes, moderately eroded	60	83	15	22	20	30	43	70	1.6	3.0		
Lucas silty clay loam, 12 to 18 percent slopes, moderately eroded					16	26	38	63	1.4	2.6		
Mermill loam	102	130	37	47	38	51	72	93	3.6	5.0	28.5	22.8
Mermill silty clay loam	101	130	35	45	35	48	69	90	3.2	5.0	27.2	22.0
Millgrove loam	102	130	36	51	42	53	74	95	3.8	5.0	29.7	23.2
Millgrove silty clay loam	98	130	34	49	38	49	70	91	3.5	5.0	29.0	22.6
Morley silt loam, 2 to 6 percent slopes	60	92	21	31	26	38	47	72	2.2	3.8		
Nappanee loam, 0 to 2 percent slopes	65	96	26	36	30	42	50	70	2.5	4.2	18.0	11.5
Nappanee loam, 2 to 6 percent slopes	65	94	24	34	28	40	48	68	2.3	4.0	17.6	11.2
Nappanee silt loam, 0 to 2 percent slopes	65	96	26	36	30	42	50	70	2.5	4.2	18.0	11.5
Nappanee silt loam, 2 to 6 percent slopes	65	94	24	34	28	40	48	68	2.3	4.0	17.6	11.2
Nappanee silty clay loam, 0 to 2 percent slopes	65	90	22	35	28	39	48	68	2.4	4.0	17.7	10.8
Ottokee loamy fine sand, 1 to 6 percent slopes	65	90	25	36	32	43	53	74	2.5	3.7		
Ottokee-Tuscola complex, 2 to 6 percent slopes	75	100	25	37	30	44	52	76	2.8	4.0	17.5	10.5

See footnotes at end of table.

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

Soil	Corn		Soybeans		Wheat		Oats		Hay		Tomatoes[1]	Sugar beets[2]
	A	B	A	B	A	B	A	B	A	B	B	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Paulding silty clay loam	70	100	26	38	30	39	39	60	2.5	4.0	------	------
Paulding clay	65	90	25	38	29	38	38	58	2.5	4.0	------	------
Pewamo silty clay loam	92	130	33	42	34	45	62	82	3.0	5.0	28.0	20.5
Rawson loam, 0 to 2 percent slopes	87	109	30	38	39	47	62	87	2.4	4.8	18.5	12.7
Rawson loam, 2 to 6 percent slopes	85	108	30	38	38	46	60	85	2.4	4.7	18.3	12.5
Rawson loam, 6 to 12 percent slopes, moderately eroded	80	100	28	33	36	44	58	82	2.2	4.5	17.5	11.5
Rimer loamy fine sand, 0 to 2 percent slopes	70	95	24	36	23	38	43	72	2.1	3.7	14.2	10.1
Rimer loamy fine sand, 2 to 6 percent slopes	70	95	22	34	22	36	41	69	2.0	3.5	------	------
Roselms silt loam, 0 to 2 percent slopes	42	62	20	29	24	32	37	63	1.8	3.4	------	------
Roselms silt loam, 2 to 6 percent slopes	39	58	18	26	23	30	35	61	1.7	3.2	------	------
Roselms silty clay loam, 0 to 2 percent slopes	41	60	20	28	24	32	37	63	1.8	3.4	------	------
Roselms silty clay loam, 2 to 6 percent slopes	38	57	18	25	23	30	35	61	1.7	3.2	------	------
St. Clair loam, 2 to 6 percent slopes	60	92	21	31	26	38	47	72	2.2	3.8	------	------
St. Clair silt loam, 2 to 6 percent slopes	60	90	21	30	26	38	47	72	2.2	3.8	------	------
St. Clair silt loam, 6 to 12 percent slopes, moderately eroded	55	80	17	24	22	33	42	67	1.8	3.1	------	------
St. Clair silt loam, 12 to 18 percent slopes, moderately eroded	------	------	------	------	------	------	------	------	------	------	------	------
Seward loamy fine sand, 0 to 2 percent slopes	60	88	25	36	28	40	45	73	2.4	3.6	10.0	9.2
Seward loamy fine sand, 2 to 6 percent slopes	60	85	22	33	26	37	42	70	2.0	3.2	------	------
Shinrock silt loam, 2 to 6 percent slopes	70	98	25	37	30	44	52	78	2.5	4.2	17.2	11.2
Shinrock silt loam, 6 to 12 percent slopes, moderately eroded	65	88	22	30	25	35	48	70	2.2	3.8	------	------
Shoals silt loam[3]	85	110	32	43	30	40	55	75	2.8	4.6	16.0	12.0
Shoals silt loam, moderately shallow variant[3]	60	80	20	30	25	30	45	60	1.8	3.0	------	------
Sloan silty clay loam[3]	87	122	30	44	32	45	63	88	2.5	5.0	24.0	19.5
Tedrow loamy fine sand, 0 to 3 percent slopes	54	86	22	32	24	36	45	72	2.1	3.4	10.2	9.5
Toledo silty clay loam	90	124	34	44	34	46	66	86	3.2	4.8	27.0	20.5
Toledo silty clay	88	122	31	42	32	44	63	82	3.0	4.6	26.0	19.7
Tuscola loam, 2 to 6 percent slopes	85	110	24	38	29	44	50	79	3.1	4.4	18.5	11.8
Tuscola-Shinrock complex, 2 to 6 percent slopes	75	105	25	38	30	44	50	78	2.8	4.3	17.8	11.5
Vaughnsville loam, 2 to 6 percent slopes	82	110	30	38	36	44	64	75	2.4	4.2	18.0	12.0
Wabasha silty clay[3]	84	116	28	40	30	42	56	81	2.5	4.5	22.5	15.5
Wabasha silty clay loam, moderately shallow variant[3]	65	90	25	32	28	35	48	70	2.0	3.5	------	------
Wauseon fine sandy loam	100	128	32	48	35	49	64	88	3.4	5.0	25.0	19.5
Willette muck	75	115	30	40	------	------	------	------	------	------	------	------

[1] Only above-average management is considered profitable; soils not rated if yield is less than 10 tons.
[2] Only above-average management is considered profitable; soils not rated if yield is less than 9 tons.
[3] Soils subject to flooding, but yields given are for areas where flooding is not a hazard or is controlled.

Woodland[1]

When the first settlers arrived in what is now Putnam County, the area was nearly covered with trees consisting mainly of hardwoods. After a century and a half of farming, only about 19,000 acres, or 6 percent of the county, remains as woodland.

The wooded areas are small, widely scattered woodlots. These woodlots have deteriorated in quality because the best trees have been cut and those of lower quality left for future growth.

Income from the sale of wood products is small, compared to that from the sale of other farm products. Some red oak, white oak, and black walnut logs of good quality are still cut from the better managed tracts, and these bring a good return when sold. Also, farm woodlots are still a source of wood for the fireplace, rough construction lumber, and edible nuts. The demand for fireplace wood and for clear, high-quality logs has increased, which offers an opportunity for improving the composition and quality of stands of white ash, white and red oaks, basswood, and black walnut through planting and good management of the existing woodland.

Besides adding to farm income, woodland provides esthetic benefits that cannot be measured in monetary terms. Trees add natural beauty to the landscape, and they provide better environment for people. These benefits contribute to the well-being and enjoyment of all the people who frequent the county, as well as to those who live there.

Wooded areas are becoming increasingly more important for recreational purposes. As the population of the county increases, the need increases for more wooded areas to provide space for camping, hiking, and hunting.

[1] A. N. QUAM, woodland conservationist, Soil Conservation Service, assisted in preparing this subsection.

The landscape in Putnam County can be improved if programs are implemented to plant trees that are adapted to the various kinds of soil. Each of the soils in the county is suited to certain species. The steep or eroded soils depend particularly on a woodland-type of permanent cover. Many abandoned open areas would benefit from a transitional crop of conifer trees that improve the soil and the site. In time these sites would support hardwoods of high value similar to those of the original woodland.

Because most of these soils are valuable for crops and are not used extensively for trees, local data about potential productivity of Putnam County soils in terms of board feet per acre is limited. Studies of site index, however, and correlations with potential yield in board feet per acre have been made on identical and on similar soils in nearby counties. This information and other limitations of these soils for woodland management are in the Technical Guide in the local Soil Conservation Service office.

On several farms in this county, windbreaks are planted to protect the farmstead from winds in winter and early in spring (fig. 2). These windbreaks also add beauty to the landscape. To the leeward a windbreak is effective for a distance of 10 to 15 times its height.

Evergreens are suitable for planting in windbreaks, and they are more effective in winter than deciduous trees. Norway spruce, Austrian pine, white pine, and arborvitae grow well on most of the soils in this county.

General forest management information is also available in the county from the county agricultural extension agent, the State service forester, the Agricultural Stabilization and Conservation Service, and the Soil Conservation Service.

Wildlife

The welfare of a wildlife species depends largely on the amount and distribution of food, shelter, and water. If any of these elements is missing, inadequate, or inaccessible, the species is absent or scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, to the resulting kinds and patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kinds of soils.

Habitat for wildlife normally can be created or improved by planting suitable vegetation, by properly managing the existing plant cover, by fostering the natural establishment of desirable plants, or by using a combination of these measures.

This subsection rates the soils of Putnam County according to their suitability for eight elements of wildlife habitat and for three classes of wildlife. Then, it explains the ratings and explains the elements and the classes of wildlife.

Figure 2.—Windbreak planted on Hoytville silty clay loam to protect pond and farm buildings.

The suitability ratings in this subsection can be used as an aid in—

1. Planning the broad use of parks, refuges, nature-study areas, and other recreational developments for wildlife.
2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the relative intensity of management needed for individual habitat elements.
4. Eliminating sites that would be difficult or not feasible to manage for specific kinds of wildlife.
5. Determining areas that are suitable for acquisition for use by wildlife.

Table 2 lists the soils in the county and rates their suitability for eight elements of wildlife habitat and for three classes, or groups, of wildlife. The ratings used are good, fair, poor, and very poor.

On soils rated *good* habitat generally is easily created, improved, or maintained. There are few or no soil limitations in habitat management, and satisfactory results are well assured.

On soils rated *fair*, habitat usually can be created, improved or maintained, but the soils have moderate limitations that affect the creation, improvement, or maintenance of the habitat. A moderate intensity of management and fairly frequent attention may be required to assure satisfactory results.

On soils rated *poor*, habitat can usually be created, improved, or maintained; but there are rather severe soil limitations. Habitat management may be difficult, expensive, and require intensive effort. Satisfactory results are questionable.

On soils rated *very poor*, it is impractical to create, improve, or maintain habitat because of the very severe soil limitations. Unsatisfactory results are probable.

Not considered in the ratings are artificial drainage of the soil, land use, the location of a soil in relation to other soils, and the mobility of wildlife.

Each soil is rated in table 2 according to its suitability for various kinds of plants and other elements that make up wildlife habitat (*1*).[2] These are discussed in the following paragraphs.

Grain and seed crops.—These crops include corn, sorghum, wheat, barley, oats, millet, buckwheat, cowpeas, and other annual plants commonly grown for grain or for seed. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer and subsoil.

Grasses and legumes.—Making up this group are domestic perennial grasses and herbaceous legumes that are established by planting and furnish wildlife cover and food. Among the plants are bluegrass, fescue, brome, timothy, orchardgrass, reed canarygrass, clover, and alfalfa. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer and subsoil.

Wild herbaceous upland plants.—In this group are native or introduced perennial grasses and weeds that generally are established naturally. They include bluestem, quackgrass, panicgrass, goldenrod, wild carrot, nightshade, and dandelion. They provide food and cover principally to upland forms of wildlife. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, surface stoniness, hazard of flooding or ponding, and texture of the surface layer and subsoil.

Hardwood woody plants.—These plants are nonconiferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat. They generally are established naturally but may be planted. Among the native kinds are oak, cherry, maple, poplar, apple, hawthorn, dogwood, persimmon, sumac, sassafras, hazelnut, black walnut, hickory, sweetgum, bayberry, blueberry, huckleberry, blackhaw, viburnum, grape, and briers. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, and surface stoniness or rockiness.

Also in this group are several varieties of fruiting shrubs that are raised commercially for planting. Autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crabapple, multiflora rose, highbush cranberry, and silky cornel dogwood are some of the shrubs that generally are available and can be planted on soils that are rated well suited. Hardwoods that are not available commercially can commonly be transplanted successfully.

Coniferous woody plants.—This element consists of cone-bearing evergreen trees and shrubs that are used by wildlife primarily as cover, though they also provide browse and seeds or fruit-like cones. Among them are Norway spruce, Virginia pine, loblolly pine, shortleaf pine, pond pine, Scotch pine, redcedar, and Atlantic whitecedar. Generally, the plants are established naturally in areas where cover of weeds and sod is thin, but they can also be planted. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, surface stoniness or rockiness, and texture of the surface layer and subsoil. Well-suited soils are those on which plants grow slowly and delay closing the canopy. It is important that branches be maintained close to the ground so that food and cover are readily available to rabbits, pheasant, and other small animals. If the trees quickly form a dense canopy that shuts out the light, the lower branches die.

On soils poorly suited to conifers for wildlife habitat, widely spaced conifers can quickly, but only temporarily, produce the desired growth. Maintaining these plants is difficult because the soils are well suited to hardwood plants. Unless the stand is carefully managed, hardwoods invade and commonly overtop the conifers.

Wetland food and cover plants.—Making up this group are wild, herbaceous, annual, and perennial plants that grow on moist to wet sites, exclusive of submerged or floating aquatics. They produce food and cover that are extensively used, mainly by wetland forms of wildlife. They include smartweed, wild millet, bulrush, sedges, barnyard grass, pondweed, duckweed, duckmillet, arrow-arum, pickerelweed, waterwillow, wetland grasses, wildrice, and cattails. The major soil properties affecting this habitat element are natural drainage, surface stoniness,

[2] Italic numbers in parentheses refer to Literature Cited, p. 111.

TABLE 2.—*Suitability of soils for elements of wildlife habitat and for kinds of wildlife*

[Soils rated 1 are good; 2, fair; 3, poor; and 4, very poor]

Soil series and map symbols	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow-water developments	Excavated ponds	Openland	Woodland	Wetland
Arkport: ArB	3	2	2	3	1	4	4	4	2	3	4
Belmore:											
BlB, BmA, BmB	1	1	1	1	3	4	4	4	1	1	4
BmC	2	1	1	1	3	4	4	4	1	1	4
Blount:											
BnA, BoA	2	2	1	1	3	2	2	2	1	2	2
BoB, BrB	2	2	1	1	3	3	3	3	1	2	3
For Del Rey part of BrB, see Del Rey series.											
Bono: Bs	4	3	3	1	1	3	1	1	3	1	2
Broughton:											
BtB, BuB2, BuC2	2	2	2	1	3	4	4	4	2	2	4
BuD2, BuE3	3	2	2	1	3	4	4	4	2	2	4
Clay pits: Cp. Too variable to be rated.											
Colwood: Cw	4	3	3	1	1	1	1	2	3	1	1
Cut and fill land: Cx. Too variable to be rated.											
Defiance: Df	2	2	2	1	3	2	2	2	2	2	2
Del Rey:											
DgA, DlA	2	2	1	1	3	2	2	2	1	2	2
DlB, DmB	2	2	1	1	3	3	3	3	1	2	3
For Fulton part of DmB, see Fulton series.											
Digby:											
DnA	2	2	1	1	3	2	2	2	1	2	2
DnB	2	2	1	1	3	3	3	3	1	2	3
Digby, moderately shallow variant: DoA	2	2	1	1	3	2	2	4	1	2	2
Fulton:											
FtA, FuA	2	2	2	1	3	3	2	2	2	2	4
FuB	2	2	2	1	3	3	3	3	2	2	2
FvA	2	2	2	1	3	3	2	2	2	2	2
Genesee: Gn	1	1	1	1	3	4	4	4	1	1	4
Gravel pits: Gp. Too variable to be rated.											
Haney:											
HaB, HdB	1	1	1	2	3	4	4	4	1	2	4
HdA	1	1	1	2	3	3	3	4	1	2	3
Haskins:											
HkA, HnA	2	2	1	1	3	2	2	2	1	2	2
HkB, HnB	2	2	1	1	3	3	3	3	1	2	3
Hoytville: Ho, Hv	4	3	3	1	1	3	1	1	3	1	2
Kibbie: KbA, KsA, KtB	2	2	1	1	3	2	2	2	1	2	2
For Del Rey part of KtB, see Del Rey series.											

TABLE 2.—*Suitability of soils for elements of wildlife habitat and for kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow-water developments	Excavated ponds	Openland	Woodland	Wetland
Latty: La, Lc	4	3	3	1	1	3	1	1	3	1	2
Lenawee: Ln, Ls	4	3	3	1	1	3	1	1	3	1	2
Lucas:											
LwB, LwC2	2	2	2	1	3	4	4	4	2	2	4
LwD2	3	2	2	1	3	4	4	4	2	2	4
Mermill: Md, Me	4	3	3	1	1	1	1	1	3	1	1
Millgrove: Mf, Mg	4	3	3	1	1	1	1	1	3	1	1
Morley: MrB	1	2	2	1	3	4	4	4	1	2	4
Nappanee:											
NaA, NpA, NtA	2	2	2	1	3	3	2	2	2	2	2
NaB, NpB	2	2	2	1	3	3	3	4	2	2	3
Ottokee: OkB, OtB For Tuscola part of OtB, see Tuscola series.	3	2	2	3	3	4	4	4	2	2	4
Paulding: Pa, Pd	4	3	3	1	3	3	1	1	3	3	2
Pewamo: Pm	4	3	3	1	3	3	1	1	3	3	2
Quarries: Qu. Too variable to be rated.											
Rawson:											
RmA	4	1	1	1	3	3	3	3	1	1	3
RmB	1	1	1	1	3	3	4	4	1	1	4
RmC2	2	1	1	1	3	4	4	4	1	1	4
Rimer:											
RnA	3	2	2	2	3	2	2	2	2	2	2
RnB	3	2	2	2	3	3	3	3	2	2	3
Roselms:											
RoA, RsA	2	2	2	1	3	3	2	2	2	2	2
RoB, RsB	2	2	2	1	3	3	3	3	2	2	3
St. Clair:											
SaB, ScB	2	2	2	1	3	4	4	4	2	2	4
ScC2	2	2	2	1	3	4	4	4	2	2	4
ScD2	3	2	2	1	3	4	4	4	2	2	4
Seward:											
SdA	3	2	2	3	3	2	2	2	2	2	2
SdB	3	2	2	3	3	3	3	3	2	2	2
Shinrock:											
SfB	1	1	1	1	3	3	4	3	1	1	4
SfC2	2	1	1	1	3	4	4	4	1	1	4
Shoals: Sh	2	2	2	1	3	2	2	2	2	2	2
Shoals, moderately shallow variant: Sk	2	2	2	1	3	2	2	4	2	2	2
Sloan: So	4	3	3	1	3	1	2	4	3	3	2
Tedrow: TdA	3	2	2	3	3	2	2	2	2	2	2
Toledo: To, Tt	4	3	3	1	3	3	1	1	3	3	2

TABLE 2.—*Suitability of soils for elements of wildlife habitat and for kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat								Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants	Wetland food and cover plants	Shallow-water developments	Excavated ponds	Openland	Woodland	Wetland
Tuscola: TuB, TwB. For Shinrock part of TwB, see Shinrock series.	1	1	1	1	3	4	4	4	1	1	4
Urban land: Ur. Too variable to be rated.											
Vaughnsville: VaB	1	1	1	1	3	4	4	4	1	1	4
Wabasha: Wa	4	3	3	1	3	3	2	4	3	3	3
Wabasha, moderately shallow variant: Wb	4	3	3	1	3	3	2	4	3	3	3
Wauseon: Wf	4	3	3	2	2	1	1	1	3	3	1
Willette: Wm	4	3	3	1	3	2	1	1	3	3	1

frequency of flooding or ponding, slope, and texture of the surface layer and subsoil.

Shallow-water developments.—These are impoundments or excavations that provide areas of shallow water, generally not exceeding 5 feet in depth, near food and cover for wetland wildlife. Examples of such developments are shallow dugouts, level ditches, blasted potholes, and devices that keep the water 6 to 24 inches deep in marshes. The major soil properties affecting this habitat element are depth to bedrock, natural drainage, slope, hazard of flooding, and surface stoniness.

Excavated ponds.—Excavated ponds are dug-out areas that generally receive their water from a permanently high water table rather than from runoff. They provide water for many kinds of wildlife, particularly for migratory or overwintering waterfowl. The major soil properties affecting this habitat element are depth to bedrock, natural drainage, surface stoniness, slope, and hazard of flooding.

Farm ponds of the impounded type are not considered in this habitat element; however, they can be important for recreational activities, including fishing, and also as a source of water for wildlife. If stocked with fish, such impoundments should be at least 6 feet deep over a large part of the area.

The three classes of wildlife rated in table 2 are briefly described in the following paragraphs.

Open-land wildlife.—Examples of open-land wildlife are quail, pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their homes in areas of cropland, pasture, meadow, and lawns and in areas overgrown with grasses, herbs, and shrubs.

Woodland wildlife.—Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrush, vireo, scarlet tanager, gray and red squirrels, gray fox, white-tailed deer, raccoon, and wild turkey. These birds and mammals obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants.

Wetland wildlife.—Duck, geese, rails, heron, shore birds, and muskrat are familiar examples of birds and mammals that normally make their homes in wet areas, such as ponds, marshes, and swamps.

Each rating under "Kinds of wildlife" in table 2 is based on the ratings listed for the habitat elements in the first part of the table. For open-land wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood plants, and coniferous woody plants. The rating for woodland wildlife is based on the ratings listed for grasses and legumes, wild herbaceous upland plants, hardwood woody plants, and coniferous woody plants. For wetland wildlife the rating is based on the ratings shown for wetland food and cover plants, shallow-water developments, and excavated ponds.

Engineering Uses of the Soils [8]

During a soil survey, considerable detailed information is catalogued about the properties of soils in the survey area, and their relation to the overall landscape. When properly interpreted, much of this information is useful to agricultural and civil engineers and to others whose work involves the use of soil mechanics or soil engineer-

[8] This subsection was reviewed by LLOYD GILLOGLY, construction engineer, Soil Conservation Service, Columbus, Ohio, and by KEITH ROWE, civil engineer, Soil Conservation Service, Defiance, Ohio.

ing data. This section has been prepared specifically for the purpose of interpreting 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 important to the engineer include permeability, compaction characteristics, soil drainage, shrink-swell characteristics, grain-size distribution, plasticity, and reaction. Depth to water table, depth to bedrock, and soil slope are also important.

Information in this survey can be used to—

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

With the use of the soil map for identification of soil areas, the engineering interpretations reported in tables 3, 4, and 5 can be useful for many purposes. It should be emphasized, however, that these interpretations do not eliminate the need for sampling and testing at the site of specific engineering works, particularly where heavy loads are to be supported and where the excavations are deeper than the depths of layers here reported. But even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

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

Engineering classification systems

Two systems of classifying soils are in general use among engineers. Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (*2*). This system is based on grain-size gradation, liquid limit, plasticity index, and field performance of soils used in constructing highways. In the AASHO system, soil materials are classified in seven principal groups. These groups range from A-1, which consists of gravelly soils having high bearing strength, to A-7, which consists of clayey soils having low strength when wet (the poorest soils for subgrade). Within each group, the relative engineering value of a soil is indicated by group index numbers that range from 0 for the best material to 20 for the poorest. The group index number is given in parentheses after the soil group symbol, for example, A-7-5(17) in table 3.

Many engineers use the Unified soil classification (*13*). In this system the soils are identified according to texture and plasticity and are grouped according to their performance as materials for engineering construction. Soil materials are identified as coarse grained (eight classes), fine grained (six classes), and highly organic.

Engineering test data

For engineering purposes, samples from nine modal profiles representing some of the principal soil series in Putnam County were tested in accordance with standard procedures. Only representative layers of each soil were tested. The results of these tests are given in table 3. The engineering classifications in this table are based on data obtained by mechanical analyses and tests for the liquid limit and the plasticity index.

Table 3 also gives moisture-density data from the standard compaction tests. If a soil material is compacted at successively higher moisture content, and the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, the density decreases as the moisture content increases. The highest dry density obtained in the compaction test is termed *maximum dry density*, and the corresponding moisture content is the *optimum moisture*. Moisture-density data are important in earthwork because, as a rule, soil is most stable within the compacted profile if it is compacted to about the maximum dry density when it is at approximately the optimum moisture content. The plastic limit is the moisture content, expressed as a percentage of the ovendry weight of the soil, 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 the soil material is plastic. Some silty and sandy soils are nonplastic; that is, they do not become plastic at any moisture content.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic state to a liquid.

TABLE 3.—*Engineering*

[Tests performed by the Soil Physical Studies Laboratory, Ohio State University, Columbus, Ohio, in accordance with standard procedures

Soil name and location	Parent material	Report No.	Depth	Moisture-density[1] Maximum dry density	Moisture-density[1] Optimum moisture
			In.	*Lb. per cu. ft.*	*Pct.*
Del Rey silt loam: Blanchard Township, SE¼SW¼ sec. 32, T. 1 N., R. 8 E. Laboratory No. PT-35.	Lacustrine clay.	19293	0–9	--------	--------
		19294	9–20	--------	--------
		19295	20–30	--------	--------
		19296	30–38	--------	--------
		19297	38–48	--------	--------
		19298	48–56	--------	--------
		19299	56–68	--------	--------
		19300	68–80	--------	--------
Fulton silty clay loam: Greensburg Township, SE¼NE¼ sec. 24, T. 1 N., R. 6 E. Laboratory No. PT-26.	Lacustrine clay.	18710	0–7	--------	--------
		18711	7–9	103	22
		18712	9–15	99	22
		18713	15–25	104	19
		18714	25–29	--------	--------
		18715	29–60	104	20
Hoytville clay: Van Buren Township, NE¼SW¼ sec. 20, T. 2 N., R. 8 E. Laboratory No. PT-24.	Clay glacial till.	18328	0–8	--------	--------
		18329	8–15	--------	--------
		18330	15–24	--------	--------
		18331	24–32	--------	--------
		18332	32–53	--------	--------
		18333	53–70	--------	--------
Monterey Township, NE¼NW¼ sec. 36, T. 1 S., R. 4 E. Laboratory No. PT-22.	Clay glacial till.	18006	0–8	--------	--------
		18007	8–17	--------	--------
		18008	17–24	--------	--------
		18009	24–35	--------	--------
		18010	35–44	--------	--------
		18011	44–60	--------	--------
		18012	60–70	--------	--------
Nappanee silt loam: Van Buren Township, NE¼SE¼ sec. 20, T. 2 N., R. 8 E. Laboratory No. PT-25.	Clay glacial till.	18334	0–8	--------	--------
		18335	8–18	--------	--------
		18336	18–26	--------	--------
		18337	26–34	--------	--------
		18338	34–48	--------	--------
		18339	48–60	--------	--------
		18340	60–77	--------	--------
		18341	77–96	--------	--------
Monterey Township, SW¼NW¼ sec. 36, T. 1 S., R. 4 E. Laboratory No. PT-21.	Clay glacial till.	18000	0–8	--------	--------
		18001	8–11	--------	--------
		18002	11–19	--------	--------
		18003	19–29	--------	--------
		18004	29–34	--------	--------
		18005	34–60	--------	--------
Paulding clay: Palmer Township, SW¼SW¼ sec. 31, T. 2 N., R. 6 E. Laboratory No. PT-19.	Lacustrine clay.	17990	0–4	--------	--------
		17991	4–8	--------	--------
		17992	8–14	--------	--------
		17993	14–20	--------	--------
		17994	20–26	--------	--------
		17995	26–32	--------	--------
		17996	32–38	--------	--------
		17997	38–44	--------	--------
		17998	44–60	--------	--------
		17999	60–70	--------	--------
Roselms clay: Greensburg Township, SW¼SW¼ sec. 32, T. 1 N., R. 6 E. Laboratory No. PT-20.	Lacustrine clay.	18244	0–7	--------	--------
		18245	7–13	--------	--------
		18246	13–19	--------	--------
		18247	19–24	--------	--------
		18248	24–30	--------	--------
		18249	30–47	--------	--------

See footnotes at end of table.

test data

adopted by the American Association of State Highway Officials (AASHO). Absence of an entry indicates that no determination was made]

Liquid limit	Plasticity index	Mechanical analysis [2]: Percentage passing sieve— No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Percentage smaller than 0.005 mm.	Classification: AASHO [3]	Unified [4]
Pct.							
----	----	100	91	70	29	----	----
40	16	100	95	79	46	A-6 (11)	ML-CL
----	----	100	93	76	48	----	----
48	19	----	----	----	----	----	----
38	15	----	----	----	----	----	----
34	12	100	93	82	43	A-6 (9)	CL
28	8	100	92	81	43	A-4 (9)	ML-CL
----	----	100	91	78	38	----	----
43	13	100	97	93	52	A-7-6 (10)	ML
----	----	100	97	94	54	----	----
47	21	100	99	97	61	A-7-6 (14)	ML-CL
51	24	100	99	98	61	A-7-6 (16)	MH-CH
----	----	100	99	98	62	----	----
----	----	100	99	99	65	----	----
----	----	100	96	84	50	----	----
----	----	100	96	86	55	----	----
55	24	100	87	56	55	A-7-5 (10)	MH-CH
57	26	100	95	86	57	A-7-5 (11)	MH-CH
55	25	100	95	87	59	A-7-5 (17)	MH-CH
42	15	100	94	85	55	A-7-6 (10)	ML-CL
----	----	100	(5)	(5)	(5)		
54	22	100	(5)	(5)	(5)	A-7-5	MH
----	----	100	(5)	(5)	(5)	----	----
55	26	100	(5)	(5)	(5)	A-7-6	MH-CH
57	28	100	(5)	(5)	(5)	A-7-6	CH-MH
53	25	100	(5)	(5)	(5)	A-7-6	CH-MH
45	18	100	(5)	(5)	(5)	A-7-6	CL-ML
----	----	100	93	77	35	----	----
62	28	100	97	89	58	A-7-5 (19)	MH
54	23	100	94	85	55	A-7-5 (16)	MH-CH
----	----	100	95	85	58	----	----
43	18	100	93	84	52	A-7-6 (12)	ML-CL
----	----	100	94	84	52	----	----
40	15	100	92	83	52	A-6 (10)	ML-CL
43	17	100	93	83	53	A-7-6 (11)	ML-CL
----	----	100	(5)	(5)	(5)	----	----
36	11	100	(5)	(5)	(5)	A-6	CL-ML
55	24	100	(5)	(5)	(5)	A-7-5	CH-MH
----	----	100	(5)	(5)	(5)	----	----
45	16	100	(5)	(5)	(5)	A-7-6	ML
43	17	100	(5)	(5)	(5)	A-7-6	CL-ML
----	----	100	(5)	(5)	(5)	----	----
66	24	100	(5)	(5)	(5)	A-7-5	MH
----	----	100	(5)	(5)	(5)	----	----
67	28	100	(5)	(5)	(5)	A-7-5	MH
64	27	100	(5)	(5)	(5)	A-7-5	MH
----	----	100	(5)	(5)	(5)	----	----
68	35	100	(5)	(5)	(5)	A-7-5	CH-MH
----	----	100	(5)	(5)	(5)	----	----
57	28	100	(5)	(5)	(5)	A-7-6	CH-MH
50	21	100	(5)	(5)	(5)	A-7-6	CH-MH
44	16	100	92	75	55	A-7-6 (11)	ML-CL
----	----	100	93	79	66	----	----
67	33	100	94	84	72	A-7-5 (20)	MH-CH
65	30	100	97	90	76	A-7-5 (20)	MH
60	29	100	98	93	82	A-7-5 (20)	MH-CH
60	28	100	98	95	85	A-7-5 (19)	MH-CH

TABLE 3.—*Engineering*

Soil name and location	Parent material	Report No.	Depth	Moisture-density[1]	
				Maximum dry density	Optimum moisture
			In.	*Lb. per cu. ft.*	*Pct.*
Toledo silty clay:					
Blanchard Township, NW¼NW¼ sec. 19, T. 1 N., R. 8 E. Laboratory No. PT-27.	Lacustrine clay.	18716	0–8	----------	----------
		18717	8–16	97	22
		18718	16–26	99	23
		18719	26–39	----------	----------
		18720	39–55	104	19
		18721	55–80	100	21

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

[2] Mechanical analyses according to the AASHO Designation T 88. 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

TABLE 4.—*Estimated soil*

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

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	Percentage passing sieve—			
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*In.*				
Arkport: ArB	>6	0–28	95–100	90–100	85–100	15–45
		28–60	95–100	90–100	85–100	10–35
		60–70	95–100	90–100	40–85	5–25
Belmore: BlB, BmA, BmB, BmC	>4	0–16	85–100	80–100	70–90	50–80
		16–40	85–100	80–100	65–90	55–85
		40–52	85–100	80–100	50–70	40–55
		52–74	80–100	65–85	40–60	10–35
*Blount: BnA, BoA, BoB, BrB	½–1½	0–7	95–100	95–100	85–100	70–85
For Del Rey part of BrB, see Del Rey series.		7–12	95–100	95–100	90–100	85–95
		12–28	90–100	85–100	85–95	80–95
		28–60	95–100	80–100	75–95	65–85
Bono: Bs	0–½	0–9	95–100	85–100	80–100	50–80
		9–30	95–100	90–100	85–100	80–95
		30–60	95–100	90–100	85–100	80–95
Broughton: BtB, BuB2, BuC2, BuD2, BuE3	1½–2	0–6	100	95–100	90–100	80–100
		6–22	100	95–100	90–100	80–100
		22–60	100	95–100	90–100	80–100
Clay pits: Cp. Properties too variable to be estimated.						

See footnotes at end of table.

test data—Continued

Liquid limit	Plasticity index	Mechanical analysis[2]: Percentage passing sieve—No. 10 (2.0 mm.)	Mechanical analysis[2]: Percentage passing sieve—No. 40 (0.42 mm.)	Mechanical analysis[2]: Percentage passing sieve—No. 200 (0.074 mm.)	Mechanical analysis[2]: Percentage smaller than 0.005 mm.	Classification: AASHO[3]	Classification: Unified[4]
Pct.							
------	------	100	98	92	58	------	------
61	25	100	98	93	61	A-7-5 (18)	MH
------	------	100	98	93	62	------	------
57	27	100	98	92	59	A-7-6 (18)	MH-CH
57	26	100	98	94	60	A-7-5 (18)	MH-CH
48	18	100	99	99	58	A-7-5 (15)	ML

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.

[3] Based on AASHO Designation M 145-49 (*2*).

[4] Based on Unified Soil Classification System.

[5] Mechanical analyses performed with sieves of slightly different sizes.

properties significant in engineering

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

Classification: USDA texture	Classification: Unified	Classification: AASHO	Permeability	Available water capacity[1]	Reaction[2]	Shrink-swell potential	Corrosion potential: Steel	Corrosion potential: Concrete
			In. per hr.	*In. per in. of soil*	*pH*			
Loamy fine sand	SM	A-2, A-4	>6.3	0.04-0.08	5.6-6.5	Low	------	Moderate.
Loamy fine sand	SM, SW-SM	A-2	2.0-6.3	0.04-0.08	5.6-7.3	Low	Low	Moderate.
Sand	SM, SW-SM	A-1, A-2, A-3	>6.3	0.02-0.05	7.4-7.8	Low	Low	Low.
Loam and sandy loam.	ML	A-4	2.0-6.3	0.14-0.18	5.6-6.5	Low	------	Low.
Clay loam	CL, ML	A-6	2.0-6.3	0.10-0.14	5.6-6.5	Low	Moderate	Low.
Sandy clay loam	SC, ML	A-4	2.0-6.3	0.10-0.14	6.6-7.3	Low	Moderate	Low to moderate.
Gravelly sandy loam.	SM, SW-SM	A-2	2.0-6.3	0.10-0.14	7.4-7.8	Low	Moderate	Low.
Silt loam	ML-CL	A-4	0.63-2.0	0.16-0.20	6.1-6.5	Low	------	Moderate.
Silty clay loam	ML-CL, CL	A-7, A-6	0.20-0.63	0.13-0.16	5.6-6.0	Moderate	High	Moderate.
Clay	CL	A-7	0.06-0.20	0.11-0.15	5.6-6.5	High	High	Moderate to low.
Clay loam	CL	A-6	0.06-0.20	0.08-0.12	7.4-8.4	Moderate	High	Low.
Silty clay loam	CL, MH	A-6	0.20-0.63	0.16-0.20	6.6-7.3	Moderate	------	Low.
Silty clay	MH, CH	A-7	0.20-0.63	0.12-0.16	6.6-7.8	High	High	Low.
Silty clay	MH, CH	A-7	0.06-0.20	0.08-0.13	7.4-8.4	High	High	Low.
Silty clay loam or clay.	CL	A-6	0.06-0.20	0.13-0.16	6.1-6.5	High	------	Low.
Clay	CH	A-7	0.06-0.20	0.12-0.16	6.1-7.8	High	High	Low.
Clay	CH	A-7	<0.06	0.09-0.14	7.4-7.8	High	High	Low.

TABLE 4.—*Estimated soil*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*In.*				
Colwood: Cw	0–½	0–22	95–100	95–100	90–100	50–75
		22–45	100	90–100	85–100	30–45
		45–60	100	100	85–100	30–60
Cut and fill land: Cx. Properties too variable to be estimated.						
Defiance: Df	[3] ½–1½	0–7	90–100	85–100	80–100	80–90
		7–11	90–100	85–100	80–100	55–80
		11–28	90–100	85–100	80–100	80–95
		28–60	90–100	85–100	80–100	80–95
Del Rey: DgA, DIA, DIB, DmB. For Fulton part of DmB, see Fulton series.	½–1½	0–8	95–100	90–100	85–100	50–80
		8–38	95–100	90–100	85–100	75–90
		38–60	95–100	90–100	85–100	75–90
Digby: DnA, DnB	½–1½	0–9	85–100	80–100	75–100	50–80
		9–18	85–100	80–100	75–100	55–85
		18–36	85–100	80–100	75–100	20–55
		36–60	80–100	70–90	40–60	5–35
Digby, moderately shallow variant: DoA	½–1½	0–10	85–100	80–100	75–100	50–80
		10–28	85–100	80–100	75–100	55–85
		>28	------	------	------	------
Fulton: FtA, FuA, FuB	½–1½	0–9	95–100	95–100	85–100	80–95
		9–29	95–100	95–100	85–100	80–100
		29–60	95–100	95–100	85–100	90–100
FvA. Estimates are for the substratum. The combined layers above the substratum are 13 inches thicker than those for other Fulton soils.	½–1½	42–50	75–100	60–75	45–65	30–50
		50–65	65–100	60–75	45–65	20–30
Genesee: Gn	[3] >3	0–8	90–100	85–100	80–100	60–90
		8–44	90–100	85–100	80–100	65–95
		44–60	90–100	85–100	80–100	65–95
Gravel pits: Gp: Properties too variable to be estimated.						
Haney: HaB, HdA, HdB	1½–2	0–9	90–100	80–100	75–100	50–75
		9–26	90–100	85–100	75–100	55–80
		26–42	85–100	80–100	75–100	40–55
		42–60	65–100	60–75	50–70	40–50
Haskins: HkA, HkB, HnA, HnB	½–1½	0–16	90–100	80–100	75–100	50–75
		16–30	85–100	80–100	75–100	50–70
		30–60	90–100	85–100	80–100	70–85
Hoytville: Ho, Hv	0–½	0–8	95–100	90–100	85–100	80–100
		8–44	95–100	90–100	85–100	80–100
		44–60	95–100	90–100	85–100	80–100
		60–70	95–100	90–100	80–100	80–95

See footnotes at end of table.

properties significant in engineering—Continued

Classification			Permeability	Available water capacity [1]	Reaction [2]	Shrink-swell potential	Corrosion potential	
USDA texture	Unified	AASHO					Steel	Concrete
			In. per hr.	*In. per in. of soil*	*pH*			
Loam	ML-CL	A-4	0.63-2.0	0.15-0.22	6.6-7.3	Low	High	Low.
Fine sandy loam	SM	A-2, A-4	2.0-6.3	0.10-0.16	6.6-7.3	Low	High	Low.
Stratified fine sand, silt, and clay.	ML, CL, SM	A-4, A-2	0.63-2.0	0.15-0.20	7.4-7.8	Low	High	Low.
Silty clay loam	CL, ML-CL	A-6	0.20-0.63	0.16-0.19	6.1-7.8	Moderate		Low.
Clay loam	CL	A-6	0.63-2.0	0.13-0.17	6.1-7.8	Moderate	High	Low.
Clay	CH	A-7	0.06-0.2	0.13-0.16	6.1-7.8	High	High	Low.
Silty clay	CH	A-7	0.06-0.20	0.09-0.14	6.1-7.8	High	High	Low.
Silt loam or loam	ML	A-4	0.63-2.0	0.15-0.20	6.1-6.5	Low	High	Moderate.
Silty clay loam	CL, ML-CL	A-6	0.20-0.63	0.16-0.19	6.1-7.8	Moderate	High	Moderate to low.
Silty clay loam	CL, ML-CL	A-6, A-4	0.06-0.20	0.14-0.17	7.4-7.8	Moderate	High	Low.
Loam	ML	A-4	0.63-2.0	0.15-0.22	6.1-6.5	Low	Moderate	Low.
Clay loam	CL, ML	A-4	0.63-2.0	0.13-0.17	5.1-5.5	Low	High	Moderate.
Sandy clay loam	SC, CL	A-4, A-2	0.63-2.0	0.11-0.15	5.1-6.0	Low	High	Low.
Fine gravel and sand.	SM, SW-SM	A-2	2.0-6.3	0.06-0.10	7.4-7.8	Low	Moderate	Low.
Loam	ML	A-4	0.63-2.0	0.15-0.22	6.1-6.5	Low	Moderate	Moderate.
Clay loam	CL, ML-CL	A-6	0.63-2.0	0.13-0.17	6.1-7.3	Moderate	High	Moderate to low.
Limestone bedrock.								
Silty clay loam	CL, ML	A-7, A-6	0.2-0.63	0.16-0.19	6.1-7.3	Moderate	High	Low.
Silty clay	ML-CL, CL, MH-CH	A-7	0.06-0.2	0.13-0.16	5.6-7.8	High	High	Moderate to low.
Silty clay	CL, CH	A-7	0.06-0.20	0.10-0.14	7.4-7.8	High	High	Low.
Gravelly sandy clay.	SM	A-2, A-4	0.63-2.0	0.11-0.15	7.4-7.8	Moderate	High	Low.
Gravelly loam	SM	A-2	2.0-6.3	0.12-0.16	7.4-7.8	Low	High	Low.
Silt loam	ML, ML-CL	A-4	0.63-2.0	0.15-0.20	6.1-6.5	Low	Low	Low.
Silt loam	ML, ML-CL	A-4	0.63-2.0	0.15-0.20	6.6-7.3	Low	Low	Low.
Stratified silt loam, loam, silty clay loam, and sandy loam.	ML, ML-CL	A-4, A-6	0.63-2.0	0.13-0.17	7.4-7.8	Low	Low	Low.
Loam or sandy loam.	ML, ML-CL	A-4	0.63-2.0	0.14-0.19	6.1-6.5	Low	Low	Low.
Clay loam	CL	A-6	0.63-2.0	0.11-0.15	5.1-6.5	Low	Low	Moderate.
Sandy clay loam	CL, SM	A-4	0.63-2.0	0.10-0.14	6.1-7.8	Low	Moderate	Low.
Gravelly loam	SM, GM	A-4	2.0-6.3	0.10-0.14	7.4-7.8	Low	Moderate	Low.
Loam or fine sandy loam.	ML, ML-CL	A-4	0.63-2.0	0.15-0.22	5.1-6.0	Low	High	Moderate.
Sandy clay loam	CL	A-4	0.63-2.0	0.10-0.14	5.6-6.5	Low	High	Moderate.
Clay	CL	A-6	<0.06	0.07-0.11	6.6-7.8	High	High	Low.
Clay or silty clay loam.	ML-CL, CH	A-6	0.63-2.0	0.14-0.17	6.1-7.3	High	High	Low.
Silty clay	ML-CL, MH, MH-CH	A-7	0.20-0.63	0.11-0.15	6.1-7.8	High	High	Low.
Silty clay	ML-CL, MH-CH	A-7	0.06-0.20	0.10-0.14	6.1-7.8	High	High	Low.
Silty clay	ML-CL, CH	A-7	0.06-0.20	0.07-0.11	6.1-7.8	High	High	Low.

TABLE 4.—*Estimated soil*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	Percentage passing sieve—			
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*In.*				
*Kibbie: KbA, KsA, KtB. For Del Rey part of KtB, see Del Rey series.	½–1½	0–9	100	100	90–100	50–75
		9–36	100	100	90–100	50–75
		36–60	100	90–100	80–95	30–40
Latty: La, Lc	0–½	0–7	95–100	90–100	85–100	80–100
		7–48	95–100	90–100	85–100	80–100
		48–60	95–100	90–100	85–100	80–100
Lenawee: Ln, Ls	0–½	0–9	95–100	90–100	85–100	80–100
		9–16	95–100	90–100	85–100	80–100
		16–48	95–100	90–100	85–100	60–80
		48–60	95–100	90–100	85–100	80–100
Lucas: LwB, LwC2, LwD2	1½–3	0–7	100	95–100	90–100	85–100
		7–12	100	95–100	90–100	90–100
		12–20	100	95–100	90–100	90–100
		20–60	100	95–100	90–100	90–100
Mermill: Md, Me	0–½	0–9	95–100	90–100	85–100	55–90
		9–20	95–100	90–100	80–100	55–80
		20–34	95–100	90–100	80–100	40–60
		34–60	95–100	90–100	85–100	80–95
Millgrove: M, Mg	0–½	0–14	95–100	90–100	85–100	55–85
		14–26	95–100	90–100	85–100	65–80
		26–42	90–100	85–100	70–90	40–60
		42–60	65–90	60–75	50–70	20–30
Morley: MrB	1½–3	0–6	95–100	90–100	85–100	75–85
		6–12	95–100	90–100	85–100	80–95
		12–25	95–100	90–100	85–100	80–95
		25–60	95–100	90–100	80–95	75–90
Nappanee: NaA, NaB, NpA, NpB, NtA	½–1½	0–11	95–100	90–100	85–100	60–90
		11–34	95–100	90–100	85–100	80–95
		34–60	95–100	90–100	85–100	75–95
*Ottokee: OkB, OtB. For Tuscola part of OtB, see Tuscola series.	1½–3	0–9	100	90–100	80–95	20–40
		9–64	100	90–100	80–95	20–40
		64–80	100	95–100	80–100	12–25
Paulding: Pa, Pd	0–½	0–6	95–100	95–100	90–100	90–100
		6–45	95–100	95–100	90–100	90–100
		45–60	95–100	95–100	90–100	90–100

See footnotes at end of table.

properties significant in engineering—Continued

Classification			Permeability	Available water capacity [1]	Reaction [2]	Shrink-swell potential	Corrosion potential	
USDA texture	Unified	AASHO					Steel	Concrete
			In. per hr.	*In. per in. of soil*	*pH*			
Loam or silt loam	ML	A-4	0.63-2.0	0.15-0.20	6.1-6.5	Low	High	Low.
Loam	ML, CL	A-4	0.63-2.0	0.14-0.18	5.6-7.3	Low	High	Low.
Fine sandy loam	SM	A-4, A-2	2.0-6.3	0.12-0.16	7.4-7.8	Low	High	Low.
Clay or silty clay loam.	MH, CH	A-7, A-6	0.06-0.2	0.14-0.17	6.1-6.5	High	High	Low.
Clay	CH	A-7	0.06-0.2	0.12-0.15	6.6-7.8	High	High	Low.
Clay	CH	A-7	<0.06	0.16-0.10	7.4-7.8	High	High	Low.
Silty clay loam or silt loam.	ML, ML-CL	A-6	0.2-0.63	0.17-0.19	6.6-7.3	Moderate	High	Low.
Silty clay loam	ML, ML-CL	A-7	0.2-0.63	0-15-0.18	6.6-7.3	Moderate	High	Low.
Clay loam	CL	A-4, A-6	0.2-0.63	0.12-0.16	6.6-7.8	Moderate	High	Low.
Stratified silty clay loam, silt loam, and sandy loam.	ML, CL	A-6	0.2-0.63	0.11-0.15	7.4-7.8	Moderate	High	Low.
Silty clay loam	CL, ML	A-6	0.2-0.63	0.16-0.18	5.6-6.0	Moderate	High	Moderate.
Silty clay	ML-CL, CH	A-7	0.2-0.63	0.12-0.16	5.1-5.5	High	High	Moderate.
Clay	ML-CL, CH	A-7	0.2-0.63	0.11-0.14	6.1-6.5	High	High	Low.
Silty clay	ML-CL, CH	A-7	0.06-0.2	0.11-0.15	7.4-7.8	High	High	Low.
Loam or silty clay loam.	ML	A-4	0.63-2.0	0.16-0.22	6.1-6.5	Low	High	Low.
Clay loam	CL	A-6	0.63-2.0	0.13-0.17	6.1-7.3	Low	High	Low.
Sandy clay loam	CL, SC	A-4	0.63-2.0	0.11-0.14	6.6-7.8	Moderate	High	Low.
Clay	CH, CL	A-6, A-7	<0.06	0.09-0.12	7.4-7.8	High	High	Low.
Loam or silty clay loam.	ML	A-4	0.63-2.0	0.16-0.22	6.1-7.3	Low	High	Low.
Clay loam	CL	A-6	0.63-2.0	0.13-0.17	6.1-7.3	Moderate	High	Low.
Sandy clay loam	CL, SC	A-4	0.63-2.0	0.11-0.15	6.6-7.8	Moderate	High	Low.
Gravelly sandy loam.	SM	A-2	2.0-6.3	0.10-0.14	7.4-7.8	Low	High	Low.
Silt loam	ML-CL	A-4	0.63-2.0	0.15-0.20	6.1-6.5	Low		Moderate.
Clay loam	CL	A-6	0.2-0.63	0.13-0.17	5.1-6.5	Moderate	High	Moderate.
Clay	CL, CH	A-6	0.06-0.20	0.11-0.16	5.6-6.5	Moderate to high.	High	Moderate.
Clay loam	CL	A-6	0.06-0.20	0.08-0.12	7.4-7.8	Moderate	High	Low.
Silt loam or silty clay loam.	CL, ML-CL	A-6	0.63-2.0	0.15-0.20	4.5-5.5	Moderate	High	Low.
Clay and silty clay.	ML, CL, MH, MH-CH	A-7	0.06-0.2	0.12-0.16	4.5-7.8	Moderate to high.	High	Low.
Silty clay	CL, ML-CL	A-6	<0.06	0.08-0.11	7.4-7.8	Moderate to high.	High	Low.
Loamy fine sand	SM	A-2, A-4	6.3-12.0	0.06-0.08	6.1-6.5	Low	Low	Low.
Loamy fine sand	SM	A-2, A-4	6.3-12.0	0.06-0.08	5.6-7.3	Low	Low	Low.
Fine sand	SM	A-2	6.3-12.0	0.03-0.06	6.6-8.4	Low	Moderate	Low.
Clay or silty clay loam.	MH, CL	A-7, A-6	0.06-0.20	0.14-0.17	6.1-6.5	High	High	Moderate.
Clay	CH, MH	A-7	<0.06	0.12-0.15	6.1-7.8	High	High	Low.
Clay	CH	A-7	<0.06	0.07-0.11	7.4-7.8	High	High	Low.

TABLE 4.—*Estimated soil*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	Percentage passing sieve—			
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*In.*				
Pewamo: Pm	0–½	0–13	100	95–100	95–100	80–95
		13–18	95–100	90–100	90–100	80–95
		18–50	95–100	90–100	90–100	80–95
		50–65	90–100	80–100	80–90	65–80
Quarries: Qu. Properties too variable to be estimated.						
Rawson: RmA, RmB, RmC2	1½–3	0–20	95–100	90–100	80–95	50–75
		20–32	90–100	80–95	50–70	35–55
		32–60	95–100	90–100	85–100	75–95
Rimer: RnA, RnB	½–1½	0–9	95–100	90–100	85–100	20–35
		9–22	95–100	90–100	85–100	20–35
		22–32	95–100	90–100	85–100	40–50
		32–60	95–100	90–100	85–100	70–90
Roselms: RoA, RoB, RsA, RsB	½–1½	0–6	95–100	90–100	85–100	75–95
		6–28	95–100	90–100	85–100	75–95
		28–60	95–100	90–100	85–100	90–100
St. Clair: SaB, ScB, ScC2, ScD2	1½–3	0–6	90–100	85–100	80–100	65–90
		6–26	95–100	90–100	85–100	80–95
		26–60	95–100	90–100	85–100	80–95
Seward: SdA, SdB	1½–3	0–28	95–100	85–100	60–85	15–40
		28–34	90–100	80–100	60–85	40–50
		34–60	95–100	90–100	85–100	80–95
Shinrock: SfB, SfC2	1½–3	0–12	90–100	85–100	80–100	65–90
		12–20	95–100	90–100	85–100	80–90
		20–31	95–100	90–100	85–100	70–95
		31–60	90–100	85–100	80–100	55–90
Shoals: Sh	[3] ½–1½	0–8	90–100	85–100	80–100	65–95
		8–28	90–100	85–100	80–100	65–90
		28–60	85–100	80–100	75–100	40–85
Shoals, moderately shallow variant: Sk	[3] ½–1½	0–8	90–100	85–100	80–100	65–85
		8–27	95–100	90–100	80–95	80–90
		>27	----------	----------	----------	----------
Sloan: So	[3] 0–½	0–8	95–100	90–100	85–100	80–90
		8–44	95–100	90–100	85–100	80–90
		44–70	85–100	80–100	70–90	55–90

See footnotes at end of table.

properties significant in engineering—Continued

Classification			Permeability	Available water capacity [1]	Reaction [2]	Shrink-swell potential	Corrosion potential	
USDA texture	Unified	AASHO					Steel	Concrete
			In. per hr.	*In. per in. of soil*	*pH*			
Silty clay loam	ML–CL	A–7	0. 20–0. 63	0. 16–0. 19	6. 6–7. 3	Moderate		Low.
Silty clay	CL, CH	A–6, A–7	0. 20–0. 63	0. 13–0. 16	6. 1–7. 3	High	High	Low.
Clay	CH, CL	A–7, A–6	0. 20–0. 63	0. 09–0. 14	6. 6–7. 8	High	High	Low.
Clay loam	CL	A–6	0. 20–0. 63	0. 09–0. 13	7. 4–7. 8	Moderate	High	Low.
Loam	ML	A–4	0. 63–2. 0	0. 14–0. 18	4. 5–6. 0	Low	Moderate	Moderate.
Sandy clay loam	SC, CL	A–4	0. 63–2. 0	0. 11–0. 15	5. 6–6. 5	Low	Moderate	Low.
Clay and heavy clay loam.	CH, CL	A–6, A–7	<0. 06	0. 08–0. 12	6. 6–7. 8	High	Moderate	Low.
Loamy fine sand	SM	A–2	6. 3–12. 0	0. 09–0. 13	6. 1–6. 5	Low	Low	Low.
Loamy fine sand	SM	A–2	6. 3–12. 0	0. 08–0. 12	5. 1–6. 0	Low	Low	Moderate.
Fine sandy loam	SM	A–4	2. 0–6. 3	0. 11–0. 15	6. 6–7. 3	Low	Low	Low.
Clay	CH, CL	A–6, A–7	0. 06–0. 20	0. 08–0. 12	6. 6–8. 4	High	High	Low.
Silt loam or silty clay loam.	CL, ML–CL	A–6, A–7	0. 20–0. 63	0. 16–0. 19	5. 6–6. 0	Moderate	High	Moderate.
Clay	MH–CH, MH, ML–CL	A–7	<0. 06	0. 12–0. 16	5. 1–7. 8	High	High	Low.
Clay	CH, ML–CL, MH–CH	A–7	<0. 06	0. 08–0. 12	7. 4–7. 8	High	High	Low.
Silt loam or loam	ML–CL	A–6	0. 63–2. 0	0. 18–0. 20	5. 6–6. 5	Low	Moderate	Moderate.
Clay	ML–CL, CH	A–7	0. 06–0. 2	0. 12–0. 16	5. 6–7. 8	High	High	Low.
Clay	CH	A–7	<0. 06	0. 08–0. 12	7. 4–7. 8	High	High	Low.
Loamy fine sand	SM	A–2, A–4	6. 3–12. 0	0. 05–0. 09	5. 6–6. 5	Low	Low	Moderate.
Fine sandy loam	SM	A–4	6. 3–12. 0	0. 09–0. 12	6. 1–7. 3	Low	Moderate	Low.
Clay	ML–CL, MH	A–7	0. 06–0. 20	0. 08–0. 12	6. 6–7. 8	High	High	Low.
Silt loam	ML	A–4	0. 63–2. 0	0. 18–0. 20	5. 6–6. 5	Low	Moderate	Moderate.
Silty clay loam	ML–CL	A–6	0. 63–2. 0	0. 15–0. 18	5. 6–6. 5	High	Moderate	Moderate.
Silty clay	CL, CH	A–7	0. 20–0. 63	0. 13–0. 15	6. 1–7. 3	High	High	Moderate.
Stratified silty clay loam, silt loam, and silty clay.	CL, MH	A–6	0. 20–0. 63	0. 12–0. 16	7. 4–7. 8	High	Moderate	Low.
Silt loam	ML–CL	A–4, A–6	0. 63–2. 0	0. 17–0. 20	6. 6–7. 3	Low	High	Low.
Silt loam	ML–CL	A–4, A–6	0. 63–2. 0	0. 17–0. 20	6. 1–7. 3	Low	High	Low.
Stratified silt loam and fine sandy loam.	ML, SM	A–4	0. 63–2. 0	0. 12–0. 16	6. 6–7. 8	Moderate	High	Low.
Silt loam	ML	A–4, A–6	0. 63–2. 0	0. 17–0. 20	6. 6–7. 3	Low	High	Low.
Silty clay loam	ML–CL, CL	A–6	0. 63–2. 0	0. 15–0. 18	6. 1–7. 8	Moderate	High	Low.
Limestone bedrock.								
Silty clay loam	ML, CL	A–4, A–6	0. 63–2. 0	0. 16–0. 19	6. 6–7. 3	Moderate	High	Low.
Silty clay loam	CL, ML–CL	A–4, A–6	0. 63–2. 0	0. 15–0. 18	6. 6–7. 3	Moderate	High	Low.
Stratified silt loam, silty clay loam, loam and sandy loam.	ML, CL	A–4, A–6	0. 63–2. 0	0. 12–0. 16	7. 4–8. 0	Moderate	High	Low.

TABLE 4.—*Estimated soil*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface (typical profile)	Percentage passing sieve—			
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
	Ft.	*In.*				
Tedrow: TdA	½–1½	0–9	85–100	80–100	60–75	15–45
		9–16	85–100	80–100	60–75	15–45
		16–44	85–100	80–100	50–70	5–35
		44–72	85–100	80–100	50–70	10–35
Toledo: To, Tt	0–½	0–8	100	100	95–100	80–100
		8–55	100	100	95–100	90–100
		55–80	100	100	95–100	90–100
*Tuscola: TuB, TwB. For Shinrock part of TwB, see Shinrock series.	1½–3	0–14	95–100	90–100	85–100	50–75
		14–32	95–100	90–100	85–100	80–95
		32–38	95–100	90–100	85–100	40–50
		38–60	95–100	90–100	85–100	80–90
Urban land: Ur. Properties too variable to be estimated.						
Vaughnsville: VaB	1½–3	0–8	95–100	90–100	85–100	50–75
		8–16	85–100	80–100	75–100	40–55
		16–30	85–100	80–100	75–100	70–85
		30–38	85–100	80–100	75–100	30–45
		38–60	85–100	80–100	70–95	70–80
Wabasha: Wa	[3] 0–½	0–6	100	100	90–100	90–100
		6–48	100	100	90–100	85–100
		48–60	100	100	90–100	80–100
Wabasha, moderately shallow variant: Wb	[3] 0–½	0–8	100	100	90–100	85–100
		8–30	100	100	90–100	90–100
		>30	---	---	---	---
Wauseon: Wf	0–½	0–9	95–100	90–100	85–100	25–50
		9–36	95–100	90–100	85–100	25–50
		36–60	95–100	90–100	85–100	80–95
Willette: Wm	0–½	0–25	---	---	---	---
		25–60	95–100	90–100	85–100	80–95

[1] A lower than normal available water capacity is shown for dense till and dense clay layers. Because these layers restrict root development, less moisture is available to plant roots.

properties significant in engineering—Continued

Classification			Permeability	Available water capacity [1]	Reaction [2]	Shrink-swell potential	Corrosion potential	
USDA texture	Unified	AASHO					Steel	Concrete
			In. per hr.	*In. per in. of soil*	*pH*			
Loamy fine sand	SM	A-2, A-4	6.3-12.0	0.06-0.10	6.1-6.5	Low	Low	Low.
Loamy fine sand	SM	A-2, A-4	6.3-12.0	0.04-0.08	6.1-6.5	Low	Low	Low.
Sand	SP-SM, SM	A-2, A-3	6.3-12.0	0.02-0.05	6.1-7.8	Low	Low	Low.
Loamy sand	SM	A-2	6.3-12.0	0.04-0.08	7.4-8.4	Low	Low	Low.
Silty clay or silty clay loam.	MH, CH	A-7	0.2-0.63	0.16-0.19	6.6-7.3	Moderate	High	Low.
Silty clay	MH-CH, CH, MH	A-7	0.06-0.20	0.13-0.16	6.6-7.8	High	High	Low.
Silty clay loam	ML, CL, CH, MH	A-7	0.06-0.20	0.08-0.12	7.4-8.0	High	High	Low.
Loam	ML	A-4	0.63-2.0	0.15-0.20	5.6-6.5	Low	Moderate	Moderate.
Silty clay loam	ML, CL	A-6	0.63-2.0	0.14-0.18	6.1-7.3	Low	Moderate	Low.
Fine sandy loam	SM	A-4	2.0-6.3	0.12-0.16	7.4-7.8	Low	Moderate	Low.
Silt loam	ML	A-4	0.63-2.0	0.15-0.19	7.4-8.0	Low	Moderate	Low.
Loam	ML, ML-CL	A-4	0.63-2.0	0.15-0.20	6.1-6.5	Low	Moderate	Low
Sandy clay loam	SC, CL	A-4	0.63-2.0	0.10-0.15	6.1-7.3	Low	Moderate	Low
Clay loam	CL	A-6	0.63-2.0	0.12-0.16	6.6-7.3	Low	Moderate	Low
Sandy loam	SM	A-4, A-2	0.63-2.0	0.12-0.16	6.6-7.3	Low	Moderate	Low
Clay loam	CL	A-6	0.06-0.20	0.10-0.14	7.4-7.8	High	Moderate	Low
Silty clay	CL, CH	A-6, A-7	0.20-0.63	0.14-0.18	6.6-7.3	High	High	Low
Clay	CH, ML-CL	A-7, A-6	0.06-0.20	0.12-0.15	6.6-7.8	High	High	Low
Stratified clay, silty clay and silty clay loam.	CH, ML-CL	A-7, A-6	0.06-0.20	0.13-0.17	7.4-7.8	High	High	Low
Silty clay loam	CL	A-6	0.2 -0.63	0.16-0.19	6.6-7.3	High	High	Low.
Silty clay	CL, CH	A-7, A-6	0.06-0.20	0.12-0.16	6.6-7.8	High	High	Low.
Limestone bedrock.								
Fine sandy loam	SM	A-2, A-4	6.3-12.0	0.13-0.17	6.6-7.3	Low	High	Low.
Fine sandy loam	SM	A-2, A-4	6.3-12.0	0.11-0.15	6.6-7.3	Low	High	Low.
Clay	CH, CL	A-7, A-6	<0.06	0.08-0.12	7.4-7.8	High	High	Low.
Muck	Pt		2.0 -6.3	0.22-0.26	5.6-7.3	Moderate	High	Low.
Clay	CH, CL	A-7, A-6	0.06-0.20	0.10-0.13	7.4-8.4	High	High	Low.

[2] Surface layer may have a higher pH than indicated if limed.
[3] Subject to flooding.

TABLE 5.—*Engineering*

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

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Arkport: ArB	Good	Low	Poor: sandy material; low fertility.	Good source of fine sand; not suitable for gravel.	Fair to good: slight compressibility; unprotected slopes are highly erodible.	Few adverse features; well drained; loose sand hinders hauling.
Belmore: BlB, BmA, BmB, BmC.	Fair	Low to moderate.	Fair to good	Fair below depth of 3 to 4 feet.	Fair in surface layer and subsoil; good in substratum.	Well drained; droughty on cut slopes.
*Blount: BnA, BoA, BoB, BrB. For Del Rey part of BrB, see Del Rey series.	Poor: plastic when wet; seasonal high water table.	High	Fair: thin suitable material.	Not suitable	Poor in clayey soil material; fair in substratum.	Clayey soil material; seasonal high water table.
Bono: Bs	Poor: seasonally wet; clayey material.	Moderate	Poor: clayey material.	Not suitable	Poor: plastic clayey material; high shrink-swell potential; high water table.	Very poorly drained; clayey material; seasonal high water table.
Broughton: BtB, BuB2, BuC2, BuD2, BuE3.	Poor: plastic when wet; sloping to steep soils.	Low	Poor: clayey material.	Not suitable	Poor: plastic soil material; high shrink-swell potential.	Plastic; clayey soil material; steep slopes.
Clay pits: Cp. No interpretations; properties too variable.						
Colwood: Cw	Poor: seasonal high water table; very poorly drained.	High	Good in surface layer; fair in subsoil to depth of 30 inches.	Not suitable; silt and very fine sand.	Fair: medium compressibility; wet in place; erodible on fills.	Seasonal high water table; soft when wet; very poorly drained.
Cut and fill land: Cx. No interpretations; properties too variable.						

interpretations of the soils

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

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Well drained; loose.	Excessive seepage; sandy material.	Subject to piping; high permeability; fair stability; fair to good compaction.	Well-drained sandy material.	Low available water capacity; rapid infiltration; susceptible to soil blowing.	Erodible sandy material; difficult to vegetate.	Erodible sandy material; difficult to vegetate.
Well drained; trench walls unstable.	Excessive seepage; sand and gravel substratum.	Subject to piping; high permeability; fair stability; fair to good compaction.	Well drained	Medium available water capacity; medium infiltration; some moderate slopes.	Short to moderate slopes; moderately deep to gravel; permeable material.	Surface layer and subsoil are moderately erodible; deep cuts expose sand and gravel; difficult to vegetate; droughty.
Seasonal high water table; clayey material.	Low seepage; seasonal high water table.	Fair to poor stability and compaction; low permeability; high shrink-swell potential.	Seasonal high water table; slow permeability; somewhat poorly drained.	Medium available water capacity; slow infiltration; seasonal high water table.	Clayey subsoil and substratum; nearly level to gently sloping; moderately erodible.	Erodible clayey subsoil; difficult to vegetate; seasonal high water table.
Very poorly drained; clayey material.	Low seepage; seasonal high water table.	Poor stability and compaction; low permeability; high shrink-swell potential; cracks when dry.	Very poorly drained; seasonal high water table; low permeability.	High available water capacity; slow infiltration; seasonal high water table.	Nearly level; clayey material; moderately erodible in channels; cuts difficult to vegetate; very poorly drained.	Nearly level; clayey material; moderately erodible in channels; cuts difficult to construct and vegetate; very poorly drained.
Moderately well drained; clayey material.	Low seepage; moderately well drained.	Fair stability; fair to poor compaction; low permeability; high volume change; cracks when dry.	Moderately well drained; very slow permeability; seasonally wet.	Low to medium available water capacity; very slow infiltration.	Clayey subsoil and substratum; sloping to steep; difficult to vegetate.	Clayey subsoil and substratum; cuts difficult to construct and vegetate; erodible.
Seasonal high water table; soft when wet; unstable trench walls.	Excessive seepage; seasonal high water table.	Poor stability; fair to poor compaction; subject to piping; medium compressibility.	Seasonal high water table; moderate permeability; nearly level.	High available water capacity; medium infiltration; seasonal high water table.	Nearly level; very poorly drained.	Very poorly drained; seasonal high water table.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Suscepti-bility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Defiance: Df	Poor: plastic soil; seasonal high water table; subject to flooding.	High	Good to fair to a depth of 10 inches; poor in subsoil; clayey.	Not suitable	Poor: plastic clayey material; poor stability and compaction; high water table; subject to flooding.	Somewhat poorly drained; seasonal high water table; flooding.
*Del Rey: DgA, DlA, DlB, DmB. For Fulton part of DmB, see Fulton series.	Poor: sticky when wet; seasonal high water table.	High	Good in surface layer; fair below; moderate fine material.	Not suitable	Fair: fair stability; seasonal high water table.	Seasonal high water table.
Digby: DnA, DnB	Poor: seasonal high water table.	Moderate to high.	Fair to depth of 18 inches; poor below.	Fair below depth of 2 to 4 feet, but contains considerable fines.	Fair: fair compaction and stability; seasonal high water table; good in substratum.	Seasonal high water table; moderate permeability.
Digby, moderately shallow variant: DoA.	Poor: seasonal high water table; limestone bedrock at depth of 2 to 3 feet.	Moderate	Fair to limestone bedrock.	Source of rock limestone below depth of 2 to 3 feet.	Fair: fair compaction and stability; seasonal high water table; limited depth over bedrock.	Seasonal high water table; moderate permeability; bedrock at depth of 2 to 3 feet.
Fulton:						
FtA, FuA, FuB	Poor: clayey soil material; seasonal high water table.	Moderate to high.	Fair in surface layer.	Not suitable	Poor: plastic clay; fair stability; medium to high compressibility; seasonal high water table.	Clayey soil; seasonal high water table.
FvA	Surface layer and subsoil poor; clayey soil material; seasonal high water table.	Moderate to high.	Fair in surface layer.	Poor source below depth of 3 to 5 feet; contains considerable fines.	Poor: plastic clay; fair stability; medium to high compressibility; seasonal high water table; substratum good to fair, has gravel and sand with variable content of fines.	Clayey soil; seasonal high water table.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Somewhat poorly drained; clayey material; subject to flooding.	Low seepage; clayey material; subject to flooding.	Poor stability; and compaction; low permeability; high volume change; cracks when dry.	Somewhat poorly drained; slow permeability; seasonal high water table; subject to flooding.	High available water capacity; slow infiltration; high water table; subject to flooding.	Nearly level, clayey soil; moderately erodible in channels; cuts difficult to vegetate; subject to flooding.	Nearly level; moderately erodible in channels; clayey soils difficult to vegetate; subject to flooding.
Seasonal high water table.	Low seepage; seasonal high water table.	Fair stability; fair to good compaction; low permeability; medium compressibility.	Seasonal high water table; slow permeability.	High available water capacity; medium infiltration; seasonal high water table.	Nearly level to gently sloping; clayey subsoil; cuts difficult to vegetate.	Clayey subsoil; difficult to vegetate; seasonally wet.
Seasonal high water table; sandy and gravelly below depth of 40 inches.	Pervious substratum, high seepage; seasonal high water table.	Fair stability; fair to good compaction; medium to high permeability when compacted.	Seasonal high water table; surface layer and subsoil moderately permeable; underlying sand and gravel; moderately rapid permeability.	Medium available water capacity; medium infiltration; seasonal high water table.	Nearly level or gently sloping; cuts expose moderately erodible sand and gravel.	Nearly level to gently sloping; moderately erodible in channels; seasonally wet.
Limestone bedrock at depth of 2 to 3 feet; seasonal high water table.	Limestone bedrock at depth of 2 to 3 feet.	Limestone bedrock at depth of 2 to 3 feet.	Seasonal high water table; moderate permeability; limestone bedrock at depth of 2 to 3 feet.	Low available water capacity; medium infiltration; limestone bedrock at depth of 2 to 3 feet.	Nearly level; limestone bedrock at depth of 2 to 3 feet.	Nearly level; moderately erodible in channels; limestone bedrock at depth of 2 to 3 feet.
Seasonal high water table; clayey subsoil and substratum.	Very low seepage; seasonal high water table.	Fair to poor compaction and stability; low permeability; high shrink-swell potential; medium to high compressibility.	Seasonal high water table; slow permeability.	Medium available water capacity; low infiltration; seasonal high water table.	Nearly level to gently sloping; clayey subsoil and substratum; cuts difficult to vegetate; moderately erodible in channels.	Nearly level to gently sloping; moderately erodible in channels; clayey subsoil and substratum; difficult to vegetate.
Seasonal high water table; clayey subsoil; gravelly substratum.	Gravelly sand strata permit high seepage; seasonal high water table.	Fair to poor compaction and stability; low permeability in clay material; pervious gravelly sand substratum.	Seasonal high water table; slow permeability; sandy, gravelly material below depth of 2 to to 3 feet.	Medium available water capacity; low infiltration; seasonal high water table.	Nearly level; seasonal high water table.	Nearly level; cuts in clayey subsoil difficult to vegetate; moderately erodible in channels.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Genesee: Gn	Poor: commonly wet; subject to flooding.	Moderate	Good to depth of 2 feet.	Not suitable	Fair: fair stability and compaction.	Good drainage; subject to flooding; nearly level.
Gravel pits: Gp. No interpretations; properties too variable to be estimated.						
Haney: HaB, HdA, HdB	Fair: seasonally wet	Moderate to low.	Good to depth of 12 inches; fair between depth of 12 and 20 inches.	Fair to good locally at a depth of 2 to 4 feet, but contains considerable fines.	Fair surface layer and subsoil; fair stability and compaction; fair to good substratum has varied content of fines.	Moderately well drained; seasonal wetness.
Haskins: HkA, HkB, HnA, HnB.	Poor: seasonal high water table.	High	Good to depth of 10 inches; fair between depth of 10 to 20 inches.	Not suitable	Fair in subsoil to depth of 2 to 3 feet; moderate shrink-swell potential: seasonal high water table; poor in substratum, plastic clay, high volume change.	Seasonal high water table; subsoil moderately permeable; substratum has clayey material at depth of 30 to 40 inches, very slowly permeable.
Hoytville: Ho, Hv	Poor: clayey material; seasonally wet.	High	Poor: high clay content.	Not suitable	Poor: plastic clay; high volume change; seasonal water table.	Seasonal high water table; plastic soil material; very poorly drained.
*Kibbie: KbA, KsA, KtB. For Del Rey part of KtB, see Del Rey series.	Poor: seasonally wet; low stability on freezing and thawing.	High	Fair to good to depth of 15 inches; fair between depth of 15 and 30 inches.	Not suitable	Poor: poor stability, high erodibility; poor compaction; seasonal high water table.	Seasonal high water table; seepage in cuts.
Latty: La, Lc	Poor: high clay content; very poorly drained.	High	Poor: high clay content.	Not suitable; fine-grained material.	Poor: plastic clay; seasonal high water table.	Seasonal high water table; plastic clayey material; very poorly drained.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Well-drained, loamy soil; subject to flooding.	Medium seepage; subject to flooding; well-drained soil.	Fair compaction and stability; medium permeability; medium compressibility.	Well drained; subject to flooding.	High available water capacity; medium infiltration; well drained; subject to flooding.	Nearly level; well drained; subject to flooding.	Nearly level; subject to flooding; well drained.
Moderately well drained; loamy material over sand or gravel.	High seepage in substratum; moderately well drained soil.	Fair to good compaction; and stability; moderate permeability; substratum has pervious gravel and sand.	Moderately well drained; gravel and sand at depth of 2 to 4 feet.	Medium available water capacity; medium infiltration.	Nearly level to gently sloping; short slopes; moderately erodible in channels.	Nearly level to gently sloping; moderately erodible in channels.
Seasonal high water table; clayey material below depth of 30 inches.	Medium seepage in subsoil to depth of 30 to 40 inches; seasonal high water table; substratum has very low seepage.	Fair compaction and stability; low permeability; substratum has high shrink-swell potential.	Seasonal high water table; moderately permeable subsoil; clayey substratum, very slowly permeable.	Medium available water capacity; medium infiltration; slow permeability below depth of 30 to 40 inches.	Nearly level to gently sloping; moderately erodible in channels; seasonal high water table.	Nearly level to gently sloping; moderately erodible in channels; seasonal high water table.
Seasonal high water table; very poorly drained; clayey material.	Low seepage; seasonal high water table.	Fair to poor compaction and stability; low permeability when compacted; high volume change; cracks when dry.	Seasonal high water table; moderately slow permeability; very poorly drained.	High available water capacity; slow infiltration; seasonal high water table.	Nearly level; clayey subsoil; cuts difficult to vegetate; moderately erodible in channels.	Nearly level clayey soil material; moderately erodible in channels; seasonally wet.
Seasonal high water table; trench walls unstable.	High seepage through sandy seams in substratum; seasonal high water table.	Poor stability and compaction; sandy permeable material, subject to piping.	Seasonal high water table; moderate permeability; nearly level.	High available water capacity; medium infiltration; seasonal high water table.	Nearly level to gently sloping; highly erodible in channels; siltation hazard.	Nearly level to gently sloping; sandy and silty material is erodible and source of siltation.
Seasonal high water table; very poorly drained; clayey material.	Low seepage; high water table.	Fair to poor stability; poor compaction; high shrink-swell po ential; cracks when dry; low permeability.	High water table; very slow permeability; very poorly drained.	Medium available water capacity; slow infiltration; high water table.	Nearly level; clayey substratum and subsoil; difficult to vegetate; very poorly drained.	Nearly level clayey soil material; moderately erodible in channels; seasonally wet.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Lenawee: Ln, Ls	Poor: seasonally wet; very poorly drained.	High	Fair to depth of 15 inches; moderate clay content.	Not suitable.	Poor to fair; fair compaction and stability; high water table.	High water table; moderately slow permeability; very poorly drained.
Lucas: LwB, LwC2, LwD2	Poor: wet in winter; slow to dry; clayey material.	Moderate	Poor: clayey material.	Not suitable.	Poor: plastic clayey material; high volume change.	Plastic clayey material; some steep slopes.
Mermill: Md, Me	Poor: very poorly drained; seasonally wet.	High	Fair to good to depth of 15 inches.	Not suitable.	Fair in subsoil; seasonal high water table; poor in substratum; plastic clayey material; very slowly permeable.	Seasonal high water table; plastic clay material at depth of 20 to 40 inches.
Millgrove: Mf, Mg	Poor: very poorly drained; seasonally wet.	Moderate	Good to depth of 20 inches.	Fair to good below depth of 3 to 4 feet; strata of sand and gravel; considerable fines in many places.	Fair: fair stability and compaction to depth of 3 to 4 feet: good in sandy and gravelly substratum; good stability.	Seasonal high water table; moderately permeable subsoil; very poorly drained.
Morley: MrB	Poor: seasonally wet and slow to dry; clayey material.	High	Fair to depth of 12 inches.	Not suitable.	Poor: surface and subsoil has plastic soil material; high volume change.	Seasonally wet; moderately well drained; slow permeability; clayey material.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Seasonal high water table; very poorly drained.	Low seepage; high water table; medium seepage in places through silt lenses.	Fair stability and compaction; medium to high compressibility; moderate shrink-swell potential; low permeability.	High water table; moderately slow permeability; very poorly drained.	High available water capacity; moderate infiltration; high water table.	Nearly level; moderately erodible in channels; very poorly drained.	Nearly level; seasonally wet; very poorly drained.
Clayey material; seasonally wet.	Moderately well drained; low seepage; high seepage in places through sand or silt lenses.	Fair stability; fair to poor compaction; high compressibility; high shrink-swell potential; cracks when dry.	Moderately well drained; seasonal high water table; slow permeability.	Medium available water capacity; slow infiltration.	Clayey subsoil at shallow depth, difficult to vegetate; seasonally wet.	Disturbed soil material is erodible; clayey subsoil; seasonally wet.
Very poorly drained; seasonal high water table; clayey.	Medium to low seepage to depth of 20 to 40 inches; low seepage in substratum; seasonal high water table.	Fair stability and compaction; high compressibility below depth of 20 to 40 inches; low permeability.	Seasonal high water table; moderately permeable subsoil; very slow permeability in substratum; very poorly drained.	Medium available water capacity; medium infiltration; seasonal high water table.	Nearly level; moderately erodible in channels; very poorly drained.	Nearly level; moderately erodible in channels; seasonally wet; very poorly drained.
Very poorly drained; sandy and gravelly substratum; nearly level.	Pervious substratum, excessive seepage; seasonal high water table.	Fair stability; fair to good compaction; poor resistance to piping; substratum has medium permeability.	Seasonal high water table; moderate permeability; sand or gravelly sand below depth of 3 to 4 feet; very poorly drained.	High available water capacity; medium infiltration; seasonal high water table.	Nearly level; cuts expose sand and gravel; difficult to vegetate; very poorly drained.	Nearly level; moderate erodibility; seasonally wet; very poorly drained.
Moderately well drained; clayey material.	Low seepage; moderately well drained.	Fair stability and compaction; low permeability; medium to high compressibility.	Moderately well drained; slow permeability; seasonally wet.	Medium available water capacity; slow infiltration; moderately well drained.	Gently sloping to sloping; clayey subsoil and substratum; cuts difficult to vegetate; moderately erodible in channels.	Gently sloping to sloping; clayey subsoil and substratum; cuts difficult to construct and vegetate.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Suscepti-bility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Nappanee: NaA, NaB, NpA, NpB, NtA.	Poor: seasonally wet, clayey material.	High	Fair in surface layer; limited suitable material.	Not suitable	Poor: plastic soil material; high compressibility; seasonal high water table.	Seasonal high water table; very slow permeability.
*Ottokee: OkB, OtB. For Tuscola part of OtB, see Tuscola series.	Good	Low	Poor: sandy material; low fertility.	Good: poorly graded fine sands, but contains some fines; not suitable for gravel.	Fair: fair stability and fair to good compaction; unprotected slopes are highly erodible.	Moderately well drained loose sand; unstable; hinders hauling operations; cuts difficult to vegetate; droughty.
Paulding: Pa, Pd	Poor: seasonal high water table; clayey soils.	Moderate to high.	Poor: high clay content.	Not suitable	Poor: plastic clay; high volume change; very slow permeability.	Plastic soil material; high water table; very slow permeability.
Pewamo: Pm	Poor: plastic when wet; seasonal high water table.	High	Fair in surface layer, clayey below.	Not suitable	Poor: clayey plastic soil material.	Plastic soil material; moderately slow permeability, seasonal high water table.
Quarries: Qu. No interpretations; properties too variable to be estimated.						
Rawson: RmA, RmB, RmC2	Fair to poor: seasonally wet; slow to dry.	Moderate	Good in surface layer.	Not suitable	Fair to depth of 2 to 3 feet; fair stability and compaction. Poor in substratum: plastic clay; high volume change.	Moderately well drained; moderately permeable; substratum is very slowly permeable plastic clay.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Somewhat poorly drained; clayey subsoil.	Low seepage; seasonal high water table.	Fair to poor stability and compaction; high compressibility; subject to cracking.	Seasonal high water table; very slow permeability.	Medium available water capacity; slow infiltration; seasonal high water table.	Nearly level to gently sloping; moderately erodible in channels; clayey subsoil and substratum; difficult to vegetate.	Nearly level to gently sloping; moderately erodible in channels; cuts difficult to vegetate; clayey material crusts and is low in organic matter.
Loose sand; trench walls very unstable; moderately well drained.	Rapid seepage; pervious sands.	Fair stability and compaction; highly permeable sands; subject to piping.	Moderately well-drained sandy soil; rapid permeability.	Low available water capacity; rapid infiltration; moderately well drained.	Nearly level to sloping; erodible sandy material; cuts difficult to vegetate; low fertility; droughty.	Nearly level to sloping; sandy material; difficult to vegetate; droughty; low fertility.
Plastic, clayey soil; very poorly drained.	Low seepage; seasonal high water table.	Fair to poor stability; high shrink-swell potential; cracks when dry.	Seasonal high water table; very slow permeability; very poorly drained.	Medium available water capacity; slow infiltration; very poorly drained.	Nearly level; dense, clayey subsoil; highly plastic, cuts difficult to construct and vegetate; very poorly drained.	Nearly level; very clayey material; seasonal high water table; difficult to construct and vegetate.
Very poorly drained; clayey material.	Low seepage; seasonal high water table.	Fair stability and compaction; medium to high compressibility; high volume change; low permeability.	Seasonal high water table; moderately slow permeability; very poorly drained.	High available water capacity; medium infiltration; seasonal high water table.	Nearly level clayey soil; moderately erodible in channels.	Nearly level; clayey material; moderately erodible in channels.
Moderately well drained; clayey below depth of 2 to 3 feet.	Moderate seepage to depth of 2 to 3 feet; low seepage below depth of 2 to 3 feet; moderately well drained.	Fair stability and compaction; substratum has high shrink-swell potential; cracks when dry.	Moderately well drained; moderate permeability; substratum is very slowly permeable.	Medium available water capacity; medium infiltration; seasonally wet.	Nearly level to sloping; moderate permeability; cuts may expose dense clayey material; difficult to vegetate.	Nearly level to sloping; moderately erodible in channels; cuts may expose plastic clay.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Suscepti- bility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Rimer: RnA, RnB	Poor: seasonal high water table; slow to dry.	Moderate to high.	Poor: sandy material; low fertility.	Fair source of poorly graded fine sand to depth of 2 to 3 feet; not suitable for gravel.	Fair to depth of 2 to 3 feet; substratum poor: plastic clay; high volume change.	Seasonal high water table; moderately rapid permeability to depth of 2 to 3 feet; substratum is clayey and slowly permeable.
Roselms: RoA, RoB, RsA, RsB.	Poor: seasonal high water table; plastic soil material.	Moderate to high.	Poor: thin; clayey.	Not suitable	Poor: plastic clay; high volume change; very slow permeability.	Seasonal high water table; very slow permeability; plastic soil material.
St. Clair: SaB, ScB, ScC2, ScD2	Poor: seasonally wet; slow to dry; clayey material.	Moderate	Poor: thin to plastic clay.	Not suitable	Poor: fair stability; high compressibility; plastic clay.	Moderately well drained; plastic soil material; moderately sloping in places.
Seward: SdA, SdB	Fair: moderately well drained; sandy soil over clay.	Moderate to low.	Poor: sandy material.	Fair source of poorly graded fine sand to depth of 2 to 3 feet; not suitable for gravel.	Good to fair to depth of 2 to 3 feet; substratum poor; plastic clay.	Moderately well drained; substratum is plastic clay.
Shinrock: SfB, SfC2	Poor: seasonally wet; slow to dry; clayey soil material.	Moderate	Good to depth of 10 inches; poor subsoil moderately clayey.	Not suitable	Fair to poor: moderately plastic; high shrink-swell potential.	Moderately well drained; clayey soil material; seasonally wet.
Shoals: Sh	Poor: seasonal high water table; subject to flooding.	High	Good to depth of 2 feet.	Not suitable	Poor: fair stability and compaction; high water table; subject to flooding.	Somewhat poorly drained; seasonal high water table; subject to flooding.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Seasonal high water table; clayey below depth of 2 to 3 feet.	High seepage in surface layer and subsoil; sandy material; low seepage in substratum; seasonal high water table.	Poor stability; fair compaction; slight compressibility; pervious to depth of 2 to 3 feet; substratum has low permeability, high volume change, cracks when dry.	Seasonal high water table; rapid permeability in sandy material; slow permeability in clayey substratum.	Low to medium available water capacity; rapid infiltration; seasonal high water table.	Nearly level to gen ly sloping sandy material; severely erodible in channels; cuts may expose plastic clay; sand or clay difficult to vegetate.	Nearly level to gently sloping; severely erodible in channels; sandy material; cuts difficult to vegetate.
Seasonal high water table; clayey soil material.	Low seepage; seasonal high water table.	Fair stability; fair to poor compaction; high compressibility; high shrink-swell potential; cracks when dry.	Seasonal high water table; very slow permeability; somewhat poorly drained.	Medium available water capacity; slow infiltration; seasonal high water table.	Nearly level to gently sloping; dense clayey subsoil; highly plastic cuts difficult to construct and vegetate.	Nearly level to sloping; very clayey plastic soil material; seasonal high water table; difficult to construct and vegetate.
Some steep soils; seasonally wet; sticky clay material.	Low seepage; moderately well drained.	Fair stability and compaction; medium to high compressibility; high shrink-swell potential; cracks when dry.	Moderately well drained; very slow permeability; seasonally wet.	Medium available water capacity; slow infiltration; sloping in places.	Gently sloping to moderately steep; moderately erodible in channels; plastic clay; cuts difficult to construct and vegetate.	Gently sloping to moderately steep; clayey soil material; moderately erodible in channels.
Seasonal wetness; clayey material below a depth of 2 to 3 feet; moderately well drained.	High seepage to depth of 2 to 3 feet; low seepage in clayey substratum.	Fair stability; fair to good compaction; subject to piping; substratum clayey, has low permeability, high volume change.	Moderately well drained; rapid permeability to depth of 2 to 3 feet; substratum clayey; slowly permeable.	Low to medium available water capacity; rapid infiltration; seasonally wet.	Nearly level to gently sloping; very erodible in channels; deep cuts expose plastic clay; difficult to vegetate.	Nearly level to gently sloping; sandy material; very erodible in channels; difficult to vegetate.
Moderately well drained; somewhat clayey soil material.	Low seepage; moderately well drained.	Fair stability and compaction; medium to high compressibility; low permeability.	Moderately well drained; moderately slow permeability; seasonally wet.	Medium available water capacity; slow infiltration rate; moderately well drained; seasonal water table.	Gently sloping to sloping; moderately erodible in channels; moderately clayey.	Gently sloping to sloping; moderately erodible in channels; clayey material; difficult to vegetate.
Somewhat poorly drained; subject to flooding.	Medium seepage; permeable sandy layer in places; seasonal high water table; subject to flooding.	Fair stability and compaction; moderate permeability; subject to piping.	Somewhat poorly drained; moderate permeability; subject to flooding.	High available water capacity; medium infiltration; seasonal high water table; subject to flooding.	Nearly level; moderately erodible in channels; subject to flooding.	Nearly level; erodible in channels; subject to flooding.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Shoals, moderately shallow variant: Sk.	Poor: seasonal high water table; subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Moderate	Good to fair above limestone bedrock.	Source of limestone bedrock at depth of 2 to 3 feet.	Poor: fair stability and compaction; high water table; subject to flooding; limited depth over bedrock.	Somewhat poorly drained; seasonal high water table; bedrock at depth of 2 to 3 feet; subject to flooding.
Sloan: So	Poor: seasonal high water table; subject to flooding.	High	Fair to good to depth of 2 feet.	Not suitable	Poor: fair stability and compaction; high water table; subject to flooding.	Very poorly drained; seasonal high water table; subject to flooding.
Tedrow: TdA	Poor: seasonal high water table; slow to dry.	Moderate	Poor: sandy material; low fertility.	Fair source of poorly graded fine sand; not suitable for gravel.	Fair: fair stability and compaction; high water table; unprotected slopes are erodible.	Somewhat poorly drained; seasonal high water table; nearly level.
Toledo: To, Tt	Poor: seasonally wet; clayey soil material.	High	Poor: clayey soil material.	Not suitable	Poor: plastic clay; high water table.	Very poorly drained; seasonal high water table; clayey soil material.
*Tuscola: TuB, TwB. For Shinrock part of TwB, see Shinrock series.	Fair: silty material dries slowly.	High	Good to depth of 12 inches; fair between depths of 12 and 24 inches.	Not suitable	Fair to poor: silty material; erodible on slopes.	Moderately well drained; seasonally wet; moderately permeable; cut slopes are very erodible.
Urban land: Ur. No interpretations; properties too variable to be estimated.						
Vaughnsville: VaB	Poor: generally wet and seepy in winter.	Moderate	Good to depth of 12 inches.	Not suitable	Good to depth of 2 to 3 feet; poor in substratum; plastic clay.	Moderately well drained; moderate permeability in subsoil; seepage in cuts; substratum clayey, slow permeability.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Limestone bedrock below depth of 2 to 3 feet; somewhat poorly drained; subject to flooding.	Limestone bedrock at depth of 2 to 3 feet.	Limestone bedrock below depth of 2 to 3 feet.	Somewhat poorly drained; moderate permeability; subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Medium available water capacity; medium infiltration; seasonal high water table; subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Nearly level; moderately erodible in channels; limestone bedrock below depth of 2 to 3 feet.	Nearly level; erodible in channels; subject to flooding; limestone bedrock below depth of 2 to 3 feet.
Very poorly drained; subject to flooding; silty material.	Medium to slow seepage, more rapid in sandy seams; subject to flooding; seasonal high water table.	Fair stability and compaction; medium compressibility; subject to piping.	Very poorly drained; moderate permeability; seasonal high water table; subject to flooding.	High available water capacity; medium infiltration; seasonal high water table; subject to flooding.	Nearly level; moderately erodible in channels; subject to flooding.	Nearly level; erodible in channels; subject to flooding; very poorly drained.
Somewhat poorly drained; sandy material; seasonally wet.	Rapid seepage; pervious sands.	Fair stability and compaction; slight compressibility; highly permeable sands; subject to piping.	Somewhat poorly drained; seasonal high water table; rapid permeability.	Low available water capacity; rapid infiltration; seasonal high water table.	Nearly level sandy material; highly erodible; seasonally wet.	Nearly level; erodible; difficult to vegetate; seasonally wet.
Very poorly drained; clayey subsoil and substratum.	Low seepage; high water table.	Poor stability and compaction; low permeability; high shrink-swell potential; cracks when dry.	Very poorly drained; seasonal high water table; slow permeability.	Medium available water capacity; slow infiltration; seasonal high water table.	Nearly level clayey soil; slow permeability; cuts difficult to vegetate; very poorly drained.	Nearly level clayey material; cuts difficult to construct and vegetate; very poorly drained.
Seasonally wet; unstable trench walls; moderately well drained.	Moderate seepage; rapid in sandy layer; moderately well drained.	Poor stability and compaction; medium compressibility; subject to piping.	Moderately well drained; seasonally wet; moderate permeability.	High available water capacity; medium infiltration; seasonal high water table.	Gently sloping; severely erodible in channels; silty and sandy material; siltation hazard.	Gently sloping; very erodible in channels; susceptible to siltation.
Moderately well drained; clayey below depth of 2 to 3 feet.	Medium seepage; rapid in some layers of subsoil; clayey substratum, has low seepage.	Good stability and compaction; moderately permeable; subject to piping; substratum has low permeability; high shrink-swell potential.	Moderately well drained; seasonally wet; moderate permeability in subsoil; receives seepage from adjacent, more permeable soils.	Medium available water capacity; medium infiltration; seasonally wet.	Gently sloping; moderately erodible in channels; cuts in clayey substratum; difficult to vegetate.	Gently sloping; moderately erodible in channels; clayey substratum; cuts difficult to vegetate.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost action	Suitability as source of—			Soil features affecting—
			Topsoil	Sand and gravel	Road fill	Highway location
Wabasha: Wa	Poor: seasonally wet; subject to flooding.	Moderate to high.	Poor: clayey.	Not suitable.	Poor: poor stability; plastic clay; high volume change; high water table; subject to flooding.	Very poorly drained; slow permeability; high water table; clayey material; subject to flooding.
Wabasha, moderately shallow variant: Wb.	Poor: seasonally wet; subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Moderate.	Poor: clayey soil material.	Source of limestone bedrock at depth below 2 to 3 feet.	Poor: poor stability; plastic clay; high volume change; high water table; subject to flooding; limited depth over bedrock.	Very poorly drained; slow permeability; high water table; clayey soil material; bedrock at depth below 2 to 3 feet; subject to flooding.
Wauseon: Wf	Poor: seasonally wet; very poorly drained.	High.	Good to depth of 20 inches.	Poor: poorly graded fine sand mixed with considerable fines to depth of 2 to 3 feet.	Fair: fair stability and compaction; high water table; erodible on slopes.	Very poorly drained; rapid permeability; clayey soil material below a depth of 2 to 3 feet; very slowly permeable.
Willette: Wm	Poor: seasonal high water table; organic matter 2 to 3 feet thick over clayey soil material.	High.	Poor if used alone, fair if mixed with mineral soil material.	Not suitable.	Not suitable: organic material over clay; seasonal high water table.	Organic material 2 to 3 feet thick; high water table; subject to ponding or flooding; unstable material; substratum is plastic clay.

interpretations of the soils—Continued

Soil features affecting—Continued						
Pipeline construction and maintenance	Farm ponds		Agricultural drainage	Irrigation	Terraces or diversions	Waterways
	Reservoir areas	Embankments				
Subject to flooding; clayey soil material; very poorly drained.	Low seepage; clayey material; high water table; subject to flooding.	Fair stability and compaction; high shrink-swell potential; cracks when dry.	Very poorly drained; seasonal high water table; slow permeability; subject to flooding.	Medium to high available water capacity; slow infiltration rate; seasonal high water table; subject to flooding.	Nearly level; clayey soil; slow permeability; moderately erodible in channels; cuts difficult to vegetate; subject to flooding.	Nearly level; clayey material; seasonal high water table; difficult to construct and vegetate; subject to flooding.
Limestone bedrock below depth of 2 to 3 feet; very poorly drained; subject to flooding.	Limestone bedrock below depth of 2 to 3 feet.	Fair stability and compaction; cracks when dry; limestone bedrock at depth of 2 to 3 feet.	Very poorly drained; seasonal high water table; limestone bedrock at depth of 2 to 3 feet; subject to flooding.	Medium available water capacity; slow infiltration; seasonal high water table; subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Nearly level; moderately erodible in channels; limestone bedrock at depth of 2 to 3 feet; subject to flooding.	Nearly level clayey material; seasonal high water table; subject to flooding; limestone bedrock at depth of 2 to 3 feet.
Very poorly drained; clayey soil material below depth of 3 feet.	High seepage in sandy material over clays; high water table; very poorly drained; low seepage in substratum.	Fair stability; fair to good compaction; sandy material susceptible to piping; substratum clayey, high volume change.	Very poorly drained; seasonally high water table; moderately rapid permeability; clayey material below depth of 2 to 3 feet.	Medium available water capacity; rapid infiltration; seasonal high water table.	Nearly level sandy material; erodible in channels; siltation hazard; very poorly drained.	Nearly level sandy material; seasonally wet; highly erodible in channels; very poorly drained.
Very poorly drained; organic material 2 to 3 feet thick; clayey substratum.	Uppermost 2 to 3 feet is organic material; high water table; variable rate of seepage; impervious clay substratum, low seepage rate.	Uppermost 2 to 3 feet is organic material; pervious; poor stability; high compressibility; clayey substratum; fair stability and compaction; high volume change; cracks when dry.	Organic material, subject to subsidence; high water table; clayey material below depth of 2 to 3 feet; very poorly drained.	Medium to high available water capacity; rapid infiltration; high water table; susceptible to soil blowing when dry.	Level to depressed; subject to ponding; organic material; deep cuts may expose clayey material; difficult to construct and vegetate.	Level to depressed organic material; highly erodible in channels; cuts may expose clayey substratum; difficult to vegetate.

Engineering properties

Table 4 shows estimated physical and chemical properties of the soils and the estimated engineering and USDA texture classifications. Additional information about the soils is given in the section "Descriptions of the Soils." Some reference to geology is given in the section "Formation and Classification of Soils" and in the section "General Nature of the County".

The estimated physical data shown in table 4 are based on the soil test data in table 3 and on field experience and test data from the same kinds of soil in other counties. The following paragraphs briefly describe the columns shown in table 4.

Depth to bedrock is not given in table 4, because bedrock generally does not occur within a depth of 5 feet, but the moderately shallow variants of the Digby, Shoals, and Wabasha series have bedrock at a depth ranging from 20 to 40 inches.

Depth to seasonal high water table.—The shallowest depth is given at which saturated soil occurs during winter and spring because of a perched or other groundwater table. Soil conditions immediately after heavy precipitation are not considered. In all soils, particularly in sloping soils on uplands, the depth to the water table is generally greater late in spring and in summer and fall than is indicated in this column.

Depth from surface.—The depths given in this column correspond to differences in properties significant to engineering in the profile described as representative for each series. It is pointed out that because the estimated data given is for the representative soil profile in each series, the depth from the surface and thickness of the major layers may vary somewhat from those shown.

Percentage passing sieve.—These columns show estimated particle-size distribution according to the standard size of sieves.

USDA texture.—The textures given correspond to the dominant textures given in the technical description of each soil.

Engineering classifications.—The estimated classifications are based on actual test data from this county and other survey areas. See the subsection "Engineering Classification Systems" for explanations of these classifications.

Permeability.—Permeability values are estimates of the range in rates of downward water movement in the major soil horizons when they are saturated but allowed to drain freely; that is, saturated above a true water table. They are estimates based on soil texture, soil structure, porosity, permeability, and infiltration tests, as well as drainage observations of the soils. In any given soil, infiltration through the surface layer varies considerably according to land use and management, as well as to initial moisture conditions.

Available water capacity.—The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Reaction.—The ranges in pH given in this column represent a summary of the many field pH determinations taken during the survey on each of the soils in the county. Liming and other management practices can result in a pH that differs from that indicated in this column. Reaction is defined in the Glossary.

Shrink-swell potential.—The estimated shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Soil materials rated high have serious limitations for engineering uses, such as highway locations and backfill for building foundations.

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

Engineering interpretations

Table 5 gives interpretations of the engineering properties of the soils in Putnam County. Interpretations for other selected uses involving engineering procedures are given in the subsection "Soils and Land Use Planning."

Table 5 lists all of the soil series in the county. It describes and rates selected characteristics of the soils that might affect their engineering usage. The interpretations shown in the table are based on actual and estimated soil test data in table 3, on the estimated properties in table 4, and on field experience. Explanations of the column headings in table 5 follow.

Suitability for winter grading.—Because of wetness, plasticity, or susceptibility to frost action, many of the soils are not adapted to grading during parts of winter. Such soils are rated as poor.

Susceptibility to frost action.—Silty and fine sandy soils that are wet most of the winter and that have a readily available source of water are most susceptible to frost action. Such soils are rated high, as are others that show evidence of frost action.

Topsoil.—The thickness, texture, and natural fertility of the surface layer determine the suitability of a soil for use as a topdressing for roadbanks and embankments to promote the growth of vegetation. Except as noted, only the surface layer of the soil is considered in this rating.

Sand and gravel.—This column gives information about the soils as a possible source of sand and gravel for construction purposes. It should not be assumed that where a soil is rated "good," that all areas of that soil can be used for commercial development for sand or gravel. A soil rated good has better possibilities for sand or gravel than soils rated poor or fair.

Road fill.—This is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Highway locations.—Soil features that affect highway location include shallow depth to rock, a high water table, steep slopes, stability, and flooding hazard. Susceptibility to frost action is an important consideration in selecting locations for highways, but it is rated separately in this table.

Pipeline construction and maintenance.—Soil features that affect pipelines are depth to hard bedrock, soil stability, high water table, and natural drainage.

Farm ponds.—In estimating features that affect reservoir areas, consideration is primarily given to the sealing potential of the reservoir. In addition, shallowness to bedrock and the susceptibility to overflow in flood plains are noted. For embankments, the soils are rated according to the stability and permeability of the materials if used in the construction of pond embankments. The permeability noted in table 5 is for the soil material when compacted at optimum moisture. The information also applies to low dikes and levees.

Agricultural drainage.—The soil features that affect agricultural drainage include natural drainage, the presence of a seasonal high water table, permeability, and depth to bedrock.

Irrigation.—Important soil features that affect irrigation are the relative ease with which water normally infiltrates into, percolates through, and drains from each of the soils, and the available moisture capacity of the soils.

Terraces and diversions.—The slope of the land and the relative erodibility of the soil material are the main considerations. Other soil features considered include depth to rock and the presence of a seasonal high water table. Nearly level soils need no terracing, and steep soils are not well suited to terracing. Highly erodible soils require special care in the construction of diversions.

Waterways.—Slope of the land and erodibility of the soil material are the main features that affect waterways. Other features are depth to rock and high water table.

Soils and Land Use Planning

The use of land in Putnam County is diversified. Most of the acreage has been used for farming, but the acreage used for residential, commercial, industrial, and recreational purposes is increasing.

Table 6 shows estimates of the degree and kind of limitation of each of the soils in Putnam County for farming and other specified uses. The degree of limitation is based on soil properties, and the limitations are rated slight, moderate, and severe. *Slight* indicates that the limitation is not serious and is easily overcome; *moderate* indicates that overcoming the limitation generally is feasible; and *severe* that the limitation is difficult and costly to overcome, and that the use of the soil for the specified purpose is questionable, though not impossible.

The interpretations in this survey should be used primarily in planning more detailed investigations to determine the condition of soil material in place at the proposed site.

The following paragraphs explain the column headings in table 6.

Farming (cultivated crops).—The degree of limitation for farming is based on the capability classification system, which is explained in the section "Capability Grouping."

Disposal of sewage effluent from septic tanks.—Homes that are built in areas that have no public sewage disposal systems require individual septic tanks and filter fields. The degree of limitation for this use depends largely on depth to the water table, flooding hazard, permeability, and slope.

A high water table that persists for an extended period interferes with the functioning of a filter field, because effluent discharged below the water table does not seep away. In slowly permeable soils, the seepage of effluent is very slow. If the soils have a sandy or gravelly substratum, effluent may seep away without adequate filtration and pollute nearby streams and other water sources. If a filter field has a steep slope, effluent may seep to the surface at the lower part of the slope.

Sewage lagoons.—These are shallow ponds built to impound and treat sewage. They may be needed in an area if septic tanks or a central sewage system is not practical. Among the features that control the degree of limitation are the hazard of flooding, degree of slope, permeability of the soil, and depth to seasonal high water table.

Homesite location.—These locations are for homes of three stories or less that have a basement, but the ratings also apply to sites for small industrial, commercial, and institutional buildings. Soil properties and some related site characteristics that are considered when rating a soil include slope, natural drainage, and the flooding hazard. Methods of sewage disposal are not considered.

Basements in poorly drained and somewhat poorly drained soils are likely to be wet unless foundation drainage is provided. By means of extensive systems of tile drains and open ditches, large areas of the wet soils in Putnam County have been made suitable for farming. Excavations for buildings are apt to disrupt these artificial drainage systems. A combination of poor natural drainage and silty texture makes some soils soft and compressible and, consequently, unfavorable for foundations. Heaving and cracking of foundations can be expected if the soils have a high shrink-swell potential. Flooding, even if infrequent, causes costly damage.

Lawns, landscaping, and golf fairways.—The degrees of limitation for these uses depend upon natural drainage, slope, depth to bedrock, texture of the surface layer, stoniness, flooding hazard, and available moisture capacity. Generally, the original surface layer in an area is better for growing lawn grasses and ornamentals than either fill brought from other areas or soil material taken from excavations. The surface layer on a site can be removed and stored until construction and grading are completed, and then returned. The natural surface layer removed in grading from areas for streets also can be used for lawns.

The amount of supplemental watering that will be needed to maintain a lawn depends largely on the depth and other features of the soil. Grading of steep slopes is likely to result in erosion unless protective measures are used.

Streets and parking lots.—In this column the soils are given suitability ratings for use for streets and parking lots in subdivisions where traffic is not continually heavy. Soil characteristics that affect this use include natural drainage, slope, and flooding hazard. Tables 4 and 5 in the engineering section of this survey give other information about the soils that are important for streets and parking lots. The degree of slope that should be designed for the sides of cuts and fill depends on the erodibility of the soil and the capacity of the soil to support close-growing vegetation.

TABLE 6.—*Estimated degree and kinds of*

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

Soil series and map symbols	Farming (cultivated crops)	Disposal of sewage effluent from septic tanks [1]	Sewage lagoons [1]	Homesite location [2] (3 stories or less)	Lawns, landscaping, and golf fairways
Arkport: ArB	Slight	Slight [3]	Severe: [3] rapid permeability in substratum.	Slight	Severe: low available water capacity; texture.
Belmore:					
BlB, BmB	Slight	Slight [3]	Severe: [3] rapid permeability.	Slight	Slight
BmA	Slight	Slight [3]	Severe: [3] moderately rapid permeability.	Slight	Slight
BmC	Moderate: erosion.	Moderate: [3] slope.	Severe: [3] rapid permeability; slope.	Moderate: slope.	Moderate: slope.
*Blount:					
BnA, BoA	Slight	Severe: slow permeability.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
BoB, BrB. For Del Rey part of BrB, see Del Rey series.	Slight	Severe: slow permeability.	Moderate: slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Bono: Bs	Moderate: wetness.	Severe: slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table; slow permeability.
Broughton:					
BtB, BuB2	Moderate: erosion.	Severe: very slow permeability.	Moderate: slope.	Moderate: high shrink-swell potential.	Severe: slow permeability.
BuC2	Severe: erosion	Severe: very slow permeability.	Severe: slope	Moderate: high shrink-swell potential; slope.	Severe: very slow permeability.
BuD2, BuE3	Severe: erosion	Severe: very slow permeability; slope.	Severe: slope	Severe: slope	Severe: very slow permeabilty; slope.
Clay pits: Cp. Commonly not used, but some sites may be suitable for some uses.					
Colwood: Cw	Slight	Severe: high water table.	Moderate: moderate permeability.	Severe: high water table.	Severe: high water table.
Cut and fill land: Cx. Commonly not used, but some sites may be suitable for some uses.					
Defiance: Df	Moderate: wetness.	Severe: [3] subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

See footnotes at end of table.

limitations of soils for specified land uses

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

Streets and parking lots [1]	Recreation				Sanitary landfill (trench type)	Cemeteries
	Athletic fields (intensive use)	Parks and play areas	Campsites			
			Tents	Trailers		
Moderate: slope.	Severe: texture.	Severe: texture.	Severe: texture.	Severe: texture.	Severe:[3] rapid permeability in substratum.	Severe: texture.
Moderate: slope.	Moderate: slope.	Slight	Slight	Moderate: slope.	Moderate:[3] moderately rapid permeability.	Slight.
Slight	Slight	Slight	Slight	Slight	Moderate:[3] moderately rapid permeability.	Slight.
Severe: slope	Severe: slope	Moderate: slope.	Moderate: slope.	Severe: slope	Moderate:[3] moderately rapid permeability; slope.	Moderate: slope.
Moderate: seasonal high water table.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.
Moderate: seasonal high water table.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.
Severe: high water table.	Severe: high water table; slow permeability.	Severe: high water table.	Severe: high water table; slow permeability.	Severe: high water table; slow permeability.	Severe: high water table.	Severe: high water table; slow permeability.
Moderate: slope.	Severe: very slow permeability.	Moderate: texture.	Severe: very slow permeability.	Severe: very slow permeability; slope.	Severe: very slow permeability.	Severe: very slow permeability.
Severe: slope	Severe: very slow permeability.	Moderate: slope.	Severe: very slow permeability.	Severe: very slow permeability; slope.	Severe: very slow permeability.	Severe: very slow permeability.
Severe: slope	Severe: very slow permeability; slope.	Severe: slope	Severe: very slow permeability.	Severe: very slow permeability; slope.	Severe: very slow permeability; slope.	Severe: very slow permeability; slope.
Severe: high water table; frost heave.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Severe: subject to flooding.	Severe: subject to flooding; slow permeability.	Moderate: subject to flooding; seasonal high water table.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

TABLE 6.—*Estimated degree and kinds of*

Soil series and map symbols	Farming (cultivated crops)	Disposal of sewage effluent from septic tanks [1]	Sewage lagoons [1]	Homesite location [2] (3 stories or less)	Lawns, landscaping, and golf fairways
*Del Rey: DgA, DlA	Slight	Severe: slow permeability.	Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.
DlB, DmB. For Fulton part of DmB, see Fulton series.	Slight	Severe: slow permeability.	Moderate: slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Digby: DnA	Slight	Moderate: seasonal high water table.	Severe: moderately rapid permeability in substratum.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
DnB	Slight	Moderate: seasonal high water table.	Severe: rapid permeability in substratum.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Digby, moderately shallow variant: DoA.	Slight	Severe: limestone bedrock at depth of 2 to 3 feet.	Severe: limestone bedrock at depth of 2 to 3 feet.	Severe: limestone bedrock at depth of 2 to 3 feet.	Moderate: seasonal high water table; limestone bedrock at depth of 2 to 3 feet.
Fulton: FtA, FuA	Moderate: wetness.	Severe: slow permeability.	Slight	Moderate: seasonal high water table.	Severe: slow permeability.
FuB	Moderate: wetness and erosion.	Severe: slow permeability.	Moderate: slope.	Moderate: seasonal high water table.	Severe: slow permeability.
FvA	Moderate: wetness.	Severe: [3] slow permeability in upper 2 to 3 feet.	Severe: [3] moderately rapid permeability in substratum.	Moderate: seasonal high water table.	Severe: slow permeability.
Genesee: Gn	Slight	Severe: [3] subject to flooding.	Severe: [3] subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Gravel pits: Gp	(4)	(4)	Severe: rapid permeability.	(4)	Severe: low available moisture capacity.
Haney: HaB, HdB	Slight	Slight	Severe: moderately rapid permeability in lower layers.	Slight	Slight
HdA	Slight	Slight	Severe: moderately rapid permeability in substratum.	Slight	Slight

See footnotes at end of table.

limitations of soils for specified land uses—Continued

Streets and parking lots [1]	Recreation: Athletic fields (intensive use)	Recreation: Parks and play areas	Recreation: Campsites: Tents	Recreation: Campsites: Trailers	Sanitary landfill (trench type)	Cemeteries
Moderate: seasonal high water table.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: seasonal high. water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Severe: limestone bedrock at depth of 2 to 3 feet.	Severe: limestone bedrock at depth of 2 to 3 feet.	Moderate: seasonal high water table; limestone bedrock at depth of 2 to 3 feet.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: limestone bedrock at depth of 2 to 3 feet.	Severe: limestone bedrock at depth of 2 to 3 feet.
Moderate: seasonal high water table.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability; seasonal high water table.
Moderate: seasonal high water table.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Moderate: seasonal high water table.	Severe: slow permeability; seasonal high water table.
Moderate: seasonal high water table.	Severe: slow permeability in upper 2 to 3 feet.	Moderate: seasonal high water table.	Severe: slow permeability.	Severe: slow permeability.	Severe: [3] moderately rapid permeability in substratum.	Severe: seasonal high water table.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: [3] subject to flooding.	Severe: subject to flooding.
([4])	([4])	([4])	([4])	([4])	Severe: [3] rapid permeability.	([4]).
Moderate: slope.	Moderate: slope.	Slight	Slight	Moderate: slope.	Moderate: moderately rapid permeability in substratum.	Moderate: seasonal high water table.
Slight	Slight	Slight	Slight	Slight	Moderate: moderately rapid permeability in substratum.	Moderate: seasonal high water table.

TABLE 6.—*Estimated degree and kinds of*

Soil series and map symbols	Farming (cultivated crops)	Disposal of sewage effluent from septic tanks [1]	Sewage lagoons [1]	Homesite location [2] (3 stories or less)	Lawns, landscaping, and golf fairways
Haskins:					
HkA, HnA	Slight	Severe: very slow permeability in lower layers.	Moderate: moderate permeability in upper 2 to 3 feet.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
HkB, HnB	Slight	Severe: very slow permeability in lower layers.	Moderate; slope	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Hoytville: Ho, Hv	Slight	Severe: slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table.
*Kibbie: KbA, KsA, KtB. For Del Rey part of KtB, see Del Rey series.	Slight	Moderate: seasonal high water table.	Moderate: moderate permeability.	Moderate: seasonal high water table.	Moderate: seasonal high water table; moderate permeability.
Latty: La, Lc	Moderate: wetness.	Severe: very slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table; very slow permeability.
Lenawee: Ln, Ls	Slight	Severe: high water table.	Slight	Severe: high water table.	Severe: high water table.
Lucas:					
LwB	Moderate: erosion.	Severe: slow permeability.	Moderate: slope	Slight	Severe: slow permeability.
LwC2	Severe: erosion	Severe: slow permeability.	Severe: slope	Moderate: slope	Severe: slow permeability.
LwD2	Severe: erosion	Severe: slow permeability; slope.	Severe: slope	Severe: slope	Severe: slow permeability; slope.
Mermill: Md, Me	Slight	Severe: very slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table.
Millgrove: Mf, Mg	Slight	Severe: high water table.	Severe: moderately rapid permeability in lower layers.	Severe: high water table.	Severe: high water table.
Morley: MrB	Moderate: erosion.	Severe: slow permeability.	Moderate: slope	Slight	Slight
Nappanee:					
NaA, NpA, NtA	Moderate: wetness.	Severe: very slow permeability.	Slight	Moderate: seasonal high water table.	Severe: very slow permeability.
NaB, NpB	Moderate: wetness and erosion.	Severe: very slow permeability.	Moderate: slope	Moderate: seasonal high water table.	Severe: very slow permeability.

See footnotes at end of table.

limitations of soils for specified land uses—Continued

Streets and parking lots [1]	Recreation				Sanitary landfill (trench type)	Cemeteries
	Athletic fields (intensive use)	Parks and play areas	Campsites			
			Tents	Trailers		
Moderate: seasonal high water table.	Severe: very slow permeability in lower layers.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: very slow permeability in lower layers: seasonal high water table.
Severe: seasonal high water table.	Severe: very slow permeability in lower layers.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: very slow permeability in lower layers: seasonal high water table.
Severe: high water table; frost heave.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table.	Severe: high water table; texture.
Severe: seasonal high water table; subject to frost heaving.	Moderate: seasonal high water table.	Moderate: seasonal high water table	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: moderate permeability; seasonal high water table.	Severe: seasonal high water table.
Severe: high water table.	Severe: high water table; very slow permeability; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; very slow permeability; texture.
Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Moderate: slope.	Severe: slow permeability.	Slight	Severe: slow permeability.	Severe: slow permeability.	Severe: texture	Severe: slow permeability.
Severe: slope	Severe: slow permeability; slope.	Moderate: slope	Severe: slow permeability.	Severe: slow permeability; slope.	Severe: texture	Severe: slow permeability.
Severe: slope	Severe: slow permeability; slope.	Severe: slope	Severe: slow permeability; slope.	Severe: slow permeability; slope.	Severe: texture; slope.	Severe: slow permeability; slope.
Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table; moderately rapid permeability in substratum.	Severe: high water table.
Moderate: slope.	Severe: slow permeability.	Slight	Severe: slow permeability.	Severe: slow permeability.	Moderate: texture.	Severe: slow permeability.
Moderate: seasonal high water table.	Severe: very slow permeability.	Moderate: seasonal high water table.	Severe: very slow permeability.	Severe: very slow permeability.	Moderate: texture; seasonal high water table.	Severe: very slow permeability.
Moderate: slope.	Severe: very slow permeability.	Moderate: seasonal high water table.	Severe: very slow permeability.	Severe: very slow permeability.	Moderate: texture; seasonal high water table.	Severe: very slow permeability.

TABLE 6.—*Estimated degree and kinds of*

Soil series and map symbols	Farming (cultivated crops)	Disposal of sewage effluent from septic tanks [1]	Sewage lagoons [1]	Homesite location [2] (3 stories or less)	Lawns, landscaping, and golf fairways
*Ottokee: OkB, OtB. For Tuscola part of OtB, see Tuscola series.	Moderate: low available water capacity.	Slight: [3] rapid permeability.	Severe: [3] rapid permeability.	Slight.	Severe: low available water capacity.
Paulding: Pa, Pd.	Moderate: wetness.	Severe: very slow permeability; high water table.	Slight.	Severe: high water table.	Severe: high water table.
Pewamo: Pm.	Slight.	Severe: moderately slow permeability; high water table.	Slight.	Severe: high water table.	Severe: high water table.
Quarries: Qu. Commonly not used.					
Rawson:					
RmA	Slight.	Severe: very slow permeability.	Slight.	Slight.	Slight.
RmB.	Slight.	Severe: very slow permeability.	Moderate: slope.	Slight.	Slight.
RmC2.	Moderate: erosion.	Severe: very slow permeability.	Severe: slope.	Moderate: slope.	Moderate: slope.
Rimer:					
RnA.	Slight.	Severe: slow permeability; seasonal high water table.	Severe: rapid permeability in upper 2 to 3 feet.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
RnB.	Slight.	Severe: slow permeability; seasonal high water table.	Severe: rapid permeability in upper 2 to 3 feet.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Roselms:					
RoA, RsA.	Moderate: wetness.	Severe: very slow permeability; seasonal high water table.	Slight.	Moderate: seasonal high water table.	Severe: very slow permeability.
RoB, RsB.	Moderate: wetness.	Severe: very slow permeability; seasonal high water table.	Moderate: slope.	Moderate: seasonal high water table.	Severe: very slow permeability.
St. Clair:					
SaB, ScB.	Moderate: erosion.	Severe: very slow permeability.	Moderate: slope.	Slight.	Severe: very slow permeability.
ScC2.	Severe: erosion.	Severe: very slow permeability.	Severe: slope.	Moderate: slope.	Severe: very slow permeability.
ScD2.	Severe: erosion.	Severe: very slow permeability; slope.	Severe: slope.	Severe: slope.	Severe: very slow permeability; slope.

See footnotes at end of table.

limitations of soils for specified land uses—Continued

Streets and parking lots [1]	Recreation: Athletic fields (intensive use)	Recreation: Parks and play areas	Recreation: Campsites: Tents	Recreation: Campsites: Trailers	Sanitary land-fill (trench type)	Cemeteries
Moderate: slope.	Severe: texture.	Severe: texture.	Severe: texture.	Severe: texture.	Severe: [3] rapid permeability.	Severe: texture.
Severe: high water table.	Severe: high water table; very slow permeability; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture; very slow permeability.
Severe: high water table.	Severe: high water table; moderately slow permeability.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table; moderately slow permeability.
Slight.	Severe: very slow permeability below depth of 2 to 3 feet.	Slight.	Severe: very slow permeability below depth of 2 to 3 feet.	Severe: very slow permeability below depth of 2 to 3 feet.	Moderate: texture.	Severe: very slow permeability.
Moderate: slope.	Severe: very slow permeability below depth of 2 to 3 feet.	Slight.	Severe: very slow permeability below depth of 2 to 3 feet.	Severe: very slow permeability below depth of 2 to 3 feet.	Moderate: texture.	Severe: very slow permeability.
Severe: slope.	Severe: slope.	Moderate: slope.	Severe: very slow permeability below depth of 2 to 3 feet.	Severe: slope.	Moderate: texture; slope.	Severe: very slow permeability.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table; texture.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table; texture.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Severe: very slow permeability.	Moderate: seasonal high water table.	Severe: very slow permeability.	Severe: very slow permeability.	Severe: texture.	Severe: very slow permeability; texture
Moderate: seasonal high water table; slope.	Severe: very slow permeability.	Moderate: seasonal high water table.	Severe: very slow permeability.	Severe: very slow permeability.	Severe: texture.	Severe: very slow permeability; texture.
Moderate: slope.	Severe: very slow permeability.	Slight.	Severe: very slow permeability.	Severe: very slow permeability.	Severe: texture.	Severe: very slow permeability.
Severe: slope.	Severe: very slow permeability; slope.	Moderate: slope.	Severe: very slow permeability.	Severe: very slow permeability; slope.	Severe: texture.	Severe: very slow permeability.
Severe: slope.	Severe: very slow permeability; slope.	Severe: slope.	Severe: very slow permeability; slope.	Severe: slow permeability; slope.	Severe: slope.	Severe: very slow permeability; slope.

TABLE 6.—*Estimated degree and kinds of*

Soil series and map symbols	Farming (cultivated crops)	Disposal of sewage effluent from septic tanks [1]	Sewage lagoons [1]	Homesite location [2] (3 stories or less)	Lawns, landscaping, and golf fairways
Seward:					
SdA	Slight	Severe: slow permeability below depth of 2 to 3 feet.	Severe: rapid permeability in upper 2 to 3 feet.	Slight	Moderate: texture.
SdB	Slight	Severe: slow permeability below depth of 2 to 3 feet.	Severe: rapid permeability in upper 2 to 3 feet.	Slight	Moderate: texture.
Shinrock:					
SfB	Slight	Severe: moderately slow permeability.	Moderate: slope	Slight	Slight: slow permeability.
SfC2	Moderate: erosion.	Severe: moderately slow permeability.	Severe: slope	Moderate: slope	Moderate: slope
Shoals: Sh	Slight	Severe: [3] subject to flooding; seasonal high water table.	Severe: [3] subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Shoals, moderately shallow variant: Sk.	Slight	Severe: [3] subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: [3] subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: subject to flooding.	Severe: subject to flooding.
Sloan: So	Moderate: wetness.	Severe:[3] subject to flooding; high water table.	Severe:[3] subject to flooding.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.
Tedrow: TdA	Slight	Moderate:[3] seasonal high water table.	Severe:[3] rapid permeability.	Moderate: seasonal high water table.	Severe: low available water capacity.
Toledo: To, Tt	Moderate: wetness.	Severe: slow permeability; high water table.	Slight	Severe: high water table.	Severe: slow permeability; high water table.
*Tuscola: TuB, TwB. For Shinrock part of TwB, see Shinrock series.	Slight	Moderate: moderate permeability.	Moderate:[3] moderate permeability; slope.	Slight	Slight
Urban Land: Ur. Not rated.					
Vaughnsville: VaB	Slight	Severe: slow permeability below depth of 2 to 3 feet.	Moderate; moderately rapid permeability in upper 2 to 3 feet.	Slight	Slight
Wabasha: Wa	Moderate: wetness.	Severe: [3] subject to flooding; high water table.	Severe: [3] subject to flooding.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.

See footnotes at end of table.

limitations of soils for specified land uses—Continued

Streets and parking lots [1]	Recreation: Athletic fields (intensive use)	Recreation: Parks and play areas	Recreation: Campsites: Tents	Recreation: Campsites: Trailers	Sanitary landfill (trench type)	Cemeteries
Slight	Moderate: texture; slow permeability below depth of 2 to 3 feet.	Moderate: texture.	Moderate: texture; slow permeability below depth of 2 to 3 feet.	Moderate: texture; slow permeability below depth of 2 to 3 feet.	Moderate: texture.	Severe: slow permeability.
Moderate: slope.	Moderate: texture; slope.	Moderate: texture.	Moderate: texture; slow permeability below depth of 2 to 3 feet.	Moderate: texture; slow permeability below depth of 2 to 3 feet.	Moderate: texture.	Severe: slow permeability.
Moderate: slope.	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: slope; moderately slow permeability.	Moderate: texture.	Moderate: moderately slow permeability.
Severe: slope	Severe: slope	Moderate: slope.	Moderate: slope.	Severe: slope	Moderate: texture; slope.	Moderate: moderately slow permeability; slope.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: [3] subject to flooding.	Severe: subject to flooding.
Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: [3] subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: subject to flooding; limestone bedrock at depth of 2 to 3 feet.
Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: [3] subject to flooding.	Severe: subject to flooding; high water table.
Moderate: seasonal high water table.	Moderate: texture; seasonal high water table.	Moderate: seasonal high water table; texture.	Moderate: texture; seasonal high water table.	Moderate: texture; seasonal high water table.	Severe: [3] rapid permeability.	Severe: seasonal high water table.
Severe: high water table.	Severe: slow permeability; high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.	Severe: high water table; texture.
Moderate: slope.	Moderate: slope.	Slight	Slight	Moderate: slope.	Moderate: seasonal high water table.	Moderate: seasonal high water batle.
Moderate: slope.	Moderate: slope.	Slight	Slight	Moderate: slope.	Moderate: [3] seasonal high water table.	Moderate: seasonal high water table.
Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: [3] subject to flooding; texture.	Severe: subject to flooding; high water table.

TABLE 6.—*Estimated degree and kinds of*

Soil series and map symbols	Farming (cultivated crops)	Disposal of sewage effluent from septic tanks [1]	Sewage lagoons [1]	Homesite location [2] (3 stories or less)	Lawns, landscaping, and golf fairways
Wabasha, moderately shallow variant: Wb.	Moderate: wetness.	Severe: [1] subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: [1] subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.
Wauseon: Wf	Slight	Severe: very slow permeability; high water table.	Slight	Severe: high water table.	Severe: high water table.
Willette: Wm	Moderate: wetness.	Severe: [1] high water table; subject to ponding.	Severe: [1] organic material.	Severe: high water table; organic material.	Severe: high water table; organic material.

[1] Additional onsite studies are needed for final decisions on location and construction of proposed works.
[2] Ratings also apply to locations for light industrial, institutional, and commercial buildings.

Recreation.—Recreation is becoming increasingly important in Putnam County. Potentially, all the soils of the county are suitable for one or more kinds of recreational development. Some soils on flood plains are well suited to some kinds of recreation because they generally are in long, winding areas along streams and are adjacent to wooded hills. Use of these soils for homes, highways, and other nonfarm purposes is severely limited by flooding. In addition, construction in these areas may hold back the natural flow of floodwater.

Among the kinds of recreational facilities that can be safely developed on some areas of flood plains are extensive play areas. Also suitable are intensive play areas, such as ball diamonds, picnic areas, and tennis courts, that are not used during the normal period of flooding and are not subject to damage from floodwaters. Flooding can cause costly damage to some recreational facilities. A determination of the frequency and duration of flooding in a local area is needed to properly evaluate the limitations for recreational uses.

Athletic fields (intensive use).—These are fairly small tracts used for baseball. football, tennis, volleyball, badminton, and other sports. Because the areas must be nearly level, considerable shaping may be needed. Consequently, slope is a limitation if it is more than 2 percent. Also important are the texture of the surface layer, permeability, natural drainage, and susceptibility to flooding.

Parks and play areas.—These sites can be located on many kinds of soil that provide a variety of wildlife and natural vegetation. Considered in rating the soils for picnicking and related hiking are natural drainage and the hazard of flooding. Paths in picnic and play areas should be constructed and maintained in a way that helps to control erosion.

Campsites.—Campsites should be located in areas where the landscape is attractive, the trafficability is good, and the productivity for grasses and trees is medium or high. Soils in which the natural drainage is good or moderately good have less serious limitations than the wetter soils. Level soils are better suited than sloping ones. Soils that are firm when moist and nonsticky when wet are most desirable. Among the soils most suitable for campsites are those having a surface layer of loam, silt loam, very fine sandy loam, fine sandy loam, and sandy loam. A slope of less than 12 percent is best for tent sites. Slope is a more critical factor for trailer sites than for tent sites.

Sanitary landfill.—Among the properties that affect the degree of limitation for sanitary land fill are drainage, flooding hazard, slope, texture, and permeability. Natural drainage is a critical factor. All soils that are subject to flooding have severe limitations. Slope is important, because heavy equipment has to be used and because of the hazard of erosion on bare slopes. Coarse-textured soils have less serious limitations than medium-textured and fine-textured soils because they are easier to move. All permeable soils are limited by the risk of contamination of ground water.

Cemeteries.—The principal soil features that affect the degree of limitation for cemeteries are ease of excavation and natural drainage. Others are susceptibility to flooding, texture, and slope. The limitation is slight if drainage is good, moderate if drainage is moderately good, and severe if drainage is poor or somewhat poor. All soils that are subject to flooding have severe limitations. If graves have to be dug below the water table, they will fill with water. Medium-textured soils have fewer limitations than coarse-textured or fine-textured soils. Slope is important because of its effect on trafficability.

limitations of soils for specified land uses—Continued

Streets and parking lots [1]	Recreation				Sanitary landfill (trench type)	Cemeteries
	Athletic fields (intensive use)	Parks and play areas	Campsites			
			Tents	Trailers		
Severe: subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe: subject to flooding; high water table.	Severe:[3] subject to flooding; limestone bedrock at depth of 2 to 3 feet.	Severe: subject to flooding; limestone bedrock at depth of 2 to 3 feet.
Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Severe: high water table; organic material.	Severe: high water table; organic material.	Severe: high water table; organic material.	Severe: high water table; organic material.	Severe: high water table; organic material.	Severe:[3] high water table; organic material.	Severe: high water table; organic material.

[3] Environmental pollution is a hazard if the soil is developed for this use. Some of the soils, including the substratum, are porous. If alluvial and other soils subject to flooding are developed, extensive pollution of the surface water can be expected.
[4] Commonly not used for the purpose specified.

Descriptions of the Soils

This section describes the soil series and mapping units in Putnam County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise indicated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Clay pits, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

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 for the description of each capability unit can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are given in table 7. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*11*).

Arkport Series

The Arkport series consists of gently sloping soils that are well drained. These soils are on sandy ridges and knolls, where they formed in thick sandy material.

In a representative profile of an Arkport soil that is cultivated, the plow layer is grayish-brown loamy fine sand about 9 inches thick. A subsurface layer is between depths of 9 and 60 inches and consists of pale-brown, loose loamy fine sand. Lamellae or bands of yellowish-brown and strong-brown fine sandy loam are between depths of 28 and 60 inches. Below a depth of 60 inches and extending to 70 inches or more is pale-brown and light brownish-gray loose sand.

Runoff is slow, and permeability is moderately rapid. Arkport soils have low organic-matter content and low available water capacity. The root zone is deep and medium acid to mildly alkaline.

Arkport soils are easy to cultivate, but they are droughty and are deficient in water, mostly during the latter part of the growing season. They are mostly used for cash-grain crops that are commonly grown in the county.

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

Soil	Acres	Percent
Arkport loamy fine sand, 2 to 6 percent slopes	83	(1)
Belmore sandy loam, 2 to 6 percent slopes	456	0.1
Belmore loam, 0 to 2 percent slopes	124	(1)
Belmore loam, 2 to 6 percent slopes	1,156	.3
Belmore loam, 6 to 12 percent slopes	192	.1
Blount loam, 0 to 2 percent slopes	103	(1)
Blount silt loam, 0 to 2 percent slopes	1,548	.5
Blount silt loam, 2 to 6 percent slopes	285	.1
Blount-Del Rey silt loams, 1 to 6 percent slopes	343	.1
Bono silty clay loam	67	(1)
Broughton silty clay loam, 2 to 6 percent slopes	743	.2
Broughton clay, 2 to 6 percent slopes, moderately eroded	379	.1
Broughton clay, 6 to 12 percent slopes, moderately eroded	1,094	.3
Broughton clay, 12 to 18 percent slopes, moderately eroded	336	.1
Broughton clay, 18 to 25 percent slopes, severely eroded	83	(1)
Clay pits	150	(1)
Colwood loam	311	.1
Cut and fill land	123	(1)
Defiance silty clay loam	384	.1
Del Rey loam, 0 to 2 percent slopes	1,118	.4
Del Rey silt loam, 0 to 2 percent slopes	3,288	1.1
Del Rey silt loam, 2 to 6 percent slopes	267	.1
Del Rey-Fulton silt loams, 1 to 6 percent slopes	4,699	1.5
Digby loam, 0 to 2 percent slopes	3,106	1.0
Digby loam, 2 to 6 percent slopes	622	.2
Digby loam, moderately shallow variant, 0 to 2 percent slopes	30	(1)
Fulton loam, 0 to 2 percent slopes	567	.2
Fulton silty clay loam, 0 to 2 percent slopes	6,721	2.2
Fulton silty clay loam, 2 to 6 percent slopes	823	.3
Fulton silty clay loam, gravelly substratum, 0 to 2 percent slopes	226	.1
Genesee silt loam	1,807	.6
Gravel pits	27	(1)
Haney sandy loam, 2 to 6 percent slopes	326	.1
Haney loam, 0 to 2 percent slopes	357	.1
Haney loam, 2 to 6 percent slopes	873	.3
Haskins fine sandy loam, 0 to 2 percent slopes	1,385	.3
Haskins fine sandy loam, 2 to 6 percent slopes	154	(1)
Haskins loam, 0 to 2 percent slopes	8,065	2.6
Haskins loam, 2 to 6 percent slopes	759	.2
Hoytville silty clay loam	35,093	11.3
Hoytville clay	41,234	13.3
Kibbie loam, 0 to 2 percent slopes	293	.1
Kibbie silt loam, 0 to 2 percent slopes	160	.1
Kibbie-Del Rey silt loams, 1 to 6 percent slopes	3,345	1.1
Latty silty clay loam	1,498	.5
Latty clay	21,963	7.1
Lenawee silt loam	1,611	.5
Lenawee silty clay loam	9,960	3.2
Lucas silty clay loam, 2 to 6 percent slopes	792	.2
Lucas silty clay loam, 6 to 12 percent slopes, moderately eroded	551	.2
Lucas silty clay loam, 12 to 18 percent slopes, moderately eroded	215	.1
Mermill loam	4,105	1.3
Mermill silty clay loam	1,841	.6
Millgrove loam	4,047	1.3
Millgrove silty clay loam	1,095	.3
Morley silt loam, 2 to 6 percent slopes	71	(1)
Nappanee loam, 0 to 2 percent slopes	2,190	.7
Nappanee loam, 2 to 6 percent slopes	230	.1
Nappanee silt loam, 0 to 2 percent slopes	7,983	2.6
Nappanee silt loam, 2 to 6 percent slopes	452	.1
Nappanee silty clay loam, 0 to 2 percent slopes	2,043	.7
Ottokee loamy fine sand, 1 to 6 percent slopes	635	.2
Ottokee-Tuscola complex, 2 to 6 percent slopes	111	(1)
Paulding silty clay loam	330	.1
Paulding clay	65,515	21.1
Pewamo silty clay loam	7,152	2.3
Quarries	112	(1)
Rawson loam, 0 to 2 percent slopes	200	.1
Rawson loam, 2 to 6 percent slopes	802	.3
Rawson loam, 6 to 12 percent slopes, moderately eroded	113	(1)
Rimer loamy fine sand, 0 to 2 percent slopes	699	.2
Rimer loamy fine sand, 2 to 6 percent slopes	212	.1
Roselms silt loam, 0 to 2 percent slopes	5,213	1.7
Roselms silt loam, 2 to 6 percent slopes	1,044	.3
Roselms silty clay loam, 0 to 2 percent slopes	6,654	2.1
Roselms silty clay loam, 2 to 6 percent slopes	584	.2
St. Clair loam, 2 to 6 percent slopes	85	(1)
St. Clair silt loam, 2 to 6 percent slopes	525	.2
St. Clair silt loam, 6 to 12 percent slopes, moderately eroded	664	.2
St. Clair silt loam, 12 to 18 percent slopes, moderately eroded	100	(1)
Seward loamy fine sand, 0 to 2 percent slopes	117	(1)
Seward loamy fine sand, 2 to 6 percent slopes	372	.1
Shinrock silt loam, 2 to 6 percent slopes	158	.1
Shinrock silt loam, 6 to 12 percent slopes, moderately eroded	141	(1)
Shoals silt loam	2,095	.7
Shoals silt loam, moderately shallow variant	72	(1)
Sloan silty clay loam	5,481	1.8
Tedrow loamy fine sand, 0 to 3 percent slopes	310	.1
Toledo silty clay loam	15,169	4.9
Toledo silty clay	7,004	2.2
Tuscola loam, 2 to 6 percent slopes	116	(1)
Tuscola-Shinrock complex, 2 to 6 percent slopes	1,143	.3
Urban land	563	.2
Vaughnsville loam, 2 to 6 percent slopes	98	(1)
Wabasha silty clay	2,191	.7
Wabasha silty clay loam, moderately shallow variant	55	(1)
Wauseon fine sandy loam	73	(1)
Willette muck	69	(1)
Individual water areas less than 40 acres each, and streams less than one-eighth mile wide	1,116	.3
Total	311,040	100.0

[1] Less than 0.05 percent.

Representative profile of Arkport loamy fine sand, 2 to 6 percent slopes, in a cultivated field in Blanchard Township, SE¼ sec. 9:

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

A21—9 to 28 inches, pale-brown (10YR 6/3) loamy fine sand; single grain; loose; slightly acid; abrupt, wavy boundary.

A22&B2t—28 to 60 inches, A22 is pale-brown (10YR 6/3) loamy fine sand; single grain; loose; B2t lamellae are yellowish-brown (10YR 5/6) and strong-brown (7.5YR 5/6) fine sandy loam; weak, fine, subangular blocky structure; very friable; clay bridges between sand grains; neutral; abrupt, irregular boundary.

C—60 to 70 inches, pale-brown (10YR 6/3) and light brownish-gray (10YR 6/2) sand; single grain; loose; moderately alkaline, calcareous.

The solum ranges from 42 to 60 inches in thickness. This commonly corresponds with the depth to carbonates. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The texture is loamy fine sand or sand. The A2 horizon has a hue of 10YR, value of 4 to 6, and chroma of 3 to 6. The B2t lamallae range from 8 to 18 inches in thickness. They have a hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 to 6. The C horizon is mildly alkaline and has a hue of 10YR, value of 4 to 6, and chroma of 2 or 3.

Arkport soils commonly are adjacent to the moderately well drained Ottokee or Seward soils. Arkport soils lack mottles that are common in Ottokee soils, and they lack the clayey IIB and IIC horizons common in Seward soils.

Arkport loamy fine sand, 2 to 6 percent slopes (ArB).—This soil is on ridges and knolls of the lake plain. Areas of this soil are oval in most places and are commonly less than 10 acres in size.

Included with this soil in mapping are small areas of Ottokee fine sand and small areas where slopes are more than 6 percent.

This Arkport soil is droughty and tends to blow where it is bare of plant cover. Soil blowing is a moderate hazard. Droughtiness and moderately rapid permeability are limitations to some nonfarm uses. Capability unit IIe-2.

Belmore Series

The Belmore series consists of nearly level to sloping soils that are well drained. These soils formed in loamy material containing sand and gravel. They most commonly are on beach ridges and stream terraces.

In a representative profile of a Belmore soil that is cultivated, the plow layer is brown loam about 9 inches thick. The subsoil is 46 inches thick. The uppermost layer is 7 inches of brown loam; the next layer is 12 inches of strong-brown clay loam; the next is 12 inches of brown clay loam; below this is 12 inches of dark-brown sandy clay loam mottled with dark brown and dark gray; and the lowermost layer is 3 inches of dark grayish-brown gravelly loam mottled with brown and dark brown. The substratum, which begins at a depth of 55 inches and extends to a depth of 74 inches, is dark grayish-brown gravelly sandy loam.

Belmore soils have moderately rapid permeability. Their root zone is deep, and they have medium available water capacity. The root zone is medium acid in the upper part unless it has been limed.

Most areas of Belmore soils are cultivated and used for cash grain. Some local areas of them are used for special crops, such as potatoes and other vegetable crops.

Representative profile of Belmore loam, 2 to 6 percent slopes, in a cultivated field in Sugar Creek Township, SE¼SE¼ sec. 1:

Ap—0 to 9 inches, brown (10YR 4/3) loam; weak, fine, granular structure; very friable; few fine pebbles; slightly acid; abrupt, smooth boundary.

B1—9 to 16 inches, brown (7.5YR 5/4) loam; weak, medium, subangular blocky structure; friable; few fine pebbles; medium acid; clear, smooth boundary.

B21t—16 to 28 inches, strong-brown (7.5YR 5/6) clay loam; moderate, medium, subangular blocky structure; friable; few fine pebbles; thin, patchy, brown (7.5YR 5/4) clay films on vertical faces of peds; medium acid; diffuse, wavy boundary.

B22t—28 to 40 inches, brown (7.5YR 5/4) clay loam; moderate, medium, subangular blocky structure; friable; thin, patchy, brown (7.5YR 5/4) clay films on vertical and horizontal faces of peds, few fine pebbles; slightly acid; gradual, wavy boundary.

B23t—40 to 52 inches, dark-brown (7.5YR 4/4) sandy clay loam that has common, medium, distinct, dark-brown (7.5YR 3/2) and dark-gray (10YR 4/1) mottles; weak, medium, subangular blocky structure; firm; thin, patchy, brown (7.5YR 5/4) clay films on vertical faces of peds; neutral; clear, wavy boundary.

B3t—52 to 55 inches, dark grayish-brown (10YR 4/2) gravelly loam that has many, medium, distinct, brown (7.5YR 5/4), and dark-brown (7.5YR 4/4) mottles; weak, medium and coarse, subangular blocky structure; friable; thin patchy, dark-brown (7.5YR 4/4) clay films on vertical faces of peds and along old root channels; mildly alkaline, calcareous; clear wavy boundary.

C—55 to 74 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam that has many, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; single grain; loose; moderately alkaline, calcareous.

The solum ranges from 45 to 55 inches in thickness. This commonly coincides with the depth to carbonates. The Ap horizon has a hue of 10YR, value of 3 to 5, and chroma of 2 or 3. The texture is loam or sandy loam. The B1 and B2 horizons have a hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 to 6. The texture in these horizons is loam, clay loam, sandy clay loam, and gravelly loam to gravelly clay loam. The content of gravel increases from about 2 percent in the upper part of the solum to 40 percent in the lower part.

Belmore soils are the well-drained members of a drainage sequence that includes the moderately well drained Haney soils, the somewhat poorly drained Digby soils, and the very poorly drained Millgrove soils. Belmore soils are adjacent to the Haney, Digby, and Millgrove soils in many places. They also are commonly adjacent to Rawson. Haskins, and Mermill soils that formed in material similar to that of Belmore soils but have a clayey C horizon within 20 to 40 inches of the surface. Belmore soils are also adjacent to the redder Vaughnsville soils in scattered, local areas on the lake side of beach ridges.

Belmore sandy loam, 2 to 6 percent slopes (BlB).—This soil commonly is on the sides of the larger beach ridges. In most places it is in long and fairly narrow areas that, at their base, are next to soils that formed in similar materials but that are not so well drained. The largest inclusions are areas of Belmore loam.

The hazard of erosion is moderate if this Belmore soil is used for farming. It has few limitations to most nonfarm uses. Capability unit IIe-1.

Belmore loam, 0 to 2 percent slopes (BmA).—This soil is on the larger beach ridges and, in places, on the stream terraces and outwash plains.

Included with this soil in mapping are areas of Belmore sandy loam. Also included in some areas are spots that have a silt loam surface layer and other areas that have 2 to 6 percent slopes.

Erosion is a hazard if this soil is used for farming. Droughtiness is a hazard to crops that mature late in the growing season. There are few limitations to most nonfarm uses. Capability unit IIe-1.

Belmore loam, 2 to 6 percent slopes (BmB).—A profile of this soil is described as representative for the series. This soil most commonly occurs as long, rather narrow areas on the beach ridges. It also is on terraces adjacent to the major streams. Included in mapping were spots of Belmore sandy loam, 2 to 6 percent slopes.

The hazard of erosion is moderate if this soil is used for farming. Except for slope, this soil has few limitations to most nonfarm uses. Capability unit IIe-1.

Belmore loam, 6 to 12 percent slopes (BmC).—This soil lies along the flanks of beach ridges and stream terraces.

Included with this soil in mapping were spots of soils that have a sandy loam and gravelly loam surface layer. Also included were areas where slopes are 12 percent to more than 35 percent.

The hazard of erosion is severe if this soil is used for farming. Slope is a severe limitation to most nonfarm uses. Capability unit IIIe-1.

Blount Series

The Blount series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in compact glacial till, mainly on the till plain south of State Route No. 12.

In a representative profile of a Blount soil that is cultivated, the plow layer is dark grayish-brown silt loam about 7 inches thick. The subsoil is 29 inches thick. The uppermost layer is 5 inches of grayish-brown, firm silty clay loam mottled with yellowish brown; the next layer is 8 inches of grayish-brown, firm clay mottled with yellowish brown; the next layer is 8 inches of yellowish-brown, firm clay mottled with dark grayish brown; and the lowermost layer is 8 inches of dark yellowish-brown, very firm clay loam mottled with gray and dark gray. The substratum, which begins at a depth of 36 inches and extends to a depth of 60 inches or more, is moderately alkaline glacial till. This material is very firm heavy clay loam that contains fragments of black shale, chert, limestone, and granite.

Blount soils have slow permeability in the subsoil and in the underlying glacial till. They are seasonally saturated with water and are slow to warm up and dry out in spring unless adequately drained. These soils have medium available water capacity. They are slightly acid to strongly acid in the upper part unless they have been limed. The root zone is moderately deep.

Blount soils are cultivated. They are used mainly for corn, soybeans, and small grain.

Representative profile of Blount silt loam, 0 to 2 percent slopes, in a cultivated field in Riley Township, SE¼ SW¼ sec. 26 ,T. 1 S., R. 8 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; 2 percent fine chert and granite pebbles; slightly acid; abrupt, smooth boundary.

B&A—7 to 12 inches, grayish-brown (10YR 5/2) silty clay loam; many, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine and medium, subangular blocky structure; firm; 2 percent fine chert and granite pebbles; medium acid; clear, wavy boundary.

B21t—12 to 20 inches, grayish-brown (10YR 5/2) clay; many medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal ped faces; 2 percent fine chert and granite pebbles; medium acid; diffuse, wavy boundary.

B22t—20 to 28 inches, yellowish-brown (10YR 5/4) clay; many, medium, distinct, dark grayish-brown (10YR 4/2) mottles; weak and moderate, medium, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical and horizontal ped faces; 5 percent fine chert, black shale, and granite pebbles; slightly acid; clear, wavy boundary.

B3t—28 to 36 inches, dark yellowish-brown (10YR 4/4) clay loam; many, medium, distinct, gray (10YR 5/1) and dark-gray (10YR 4/1) mottles; weak, coarse, subangular blocky structure; very firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces and along old root channels; 10 percent fine chert, black shale, granite, and limestone pebbles; moderately alkaline, calcareous; diffuse, wavy boundary.

C—36 to 60 inches, dark-brown (10YR 4/3) heavy clay loam; many, medium, distinct, gray (10YR 5/1) mottles; massive; very firm; 10 percent fine chert, black shale, granite, and limestone pebbles; moderately alkaline, calcareous; glacial till.

The solum ranges from 25 to 44 inches in thickness. The Ap horizon has a hue of 10YR, a value of 4 to 6, and a chroma of 1 or 2. The texture is silt loam or loam. The B21t horizon is 10YR in hue, 4 to 6 in value, and 2 to 4 in chroma. It is mottled in hues of 10YR and 7.5YR, value of 4 to 6, and chroma of 4 to 8. The texture in this horizon ranges from silty clay loam to clay. The B22t horizon has a hue of 10YR, values of 4 and 5, and chroma of 3 to 6. The mottles have a hue of 10YR, value of 4 to 6, and chroma of 2. Texture ranges from silty clay loam to clay. The B3t and C horizons are 10YR in hue; value is 4 or 5, and chroma is 3 or 4. These horizons are mottled with gray or dark gray. The texture ranges from clay to clay loam.

The sand content in the upper part of the B horizon is higher than in the range defined for the series, but this difference does not alter the usefulness or behavior of these soils.

Blount soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Morley soils and the very poorly drained Pewamo soils. Blount soils contain less clay in their B and C horizons than the nearby Nappanee soils.

Blount loam, 0 to 2 percent slopes (BnA).—This soil is mainly in small areas, generally 5 to 10 acres in size, that are well scattered across the till plain. There are a few larger areas, 10 to 20 acres in size, near beach ridges and terraces. This soil generally is in slightly higher positions than Blount silt loam, 0 to 2 percent slopes. Its profile is similar to the one described as representative for the series, but its plow layer has more sand and is as much as 14 inches thick in places. Generally, the plow layer is 10 to 12 inches thick. This soil is easier to cultivate and is less subject to surface crusting than Blount silt loam, 0 to 2 percent slopes, because the plow layer is sandier.

Included with this soil in mapping were small areas of the coarser textured Haskins loam, 0 to 2 percent slopes.

A seasonal high water table is the main limitation to farm use. Seasonal wetness and slow permeability are limitations to nonfarm uses. Capability unit IIw-4.

Blount silt loam, 0 to 2 percent slopes (BoA).—This soil is mostly on the till plain in the southeastern and east-central parts of the county. Much of it is on small, low knolls that are surrounded by or are adjacent to lower areas of Pewamo soils. A profile of this soil is described as representative for the series. This Blount soil is highly subject to surface crusting because its organic-matter content is low and its silt content is high. Generally, it is not subject to ponding, whereas the adjacent Pewamo soils are subject to ponding. Thus, where the two soils are farmed together, these diverse features tend to complicate soil management.

Included with this soil in mapping were small areas of Pewamo silty clay loam in depressions and along drainageways.

A seasonal high water table is the main limitation to farm use. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw-4.

Blount silt loam, 2 to 6 percent slopes (BoB).—This soil is mostly in the southeastern part of the county near stream valleys. A few, small, scattered areas of it are in the east-central part. Most areas are adjacent to areas of Morley soils and, to a lesser extent, Pewamo soils. Because of the slope, surface water flows away more readily on this soil and is more likely to cause erosion than on Blount silt loam, 0 to 2 percent slopes.

Included with this soil in mapping were small areas of moderately eroded soils, small areas of moderately well drained Morley soils, and small areas of Blount silt loam, 0 to 2 percent slopes. Also included were a few small areas of the very poorly drained Pewamo silty clay loam.

A seasonal high water table is the main limitation to farm use. Erosion is a hazard, particularly in the more sloping areas. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw-4.

Blount-Del Rey silt loams, 1 to 6 percent slopes (BrB).—This complex is in the east-central part of the county. It consists of Blount and Del Rey soils in areas so small and intermingled that it is not possible to show each soil separately on the soil map. Most of the areas are oval in shape and are adjacent to low-lying areas of very poorly drained Toledo soils. This complex is about 35 percent Blount silt loam and 35 percent Del Rey silt loam; the remaining 30 percent is inclusions of the finer textured Nappanee soils and the coarser textured Kibbie soils.

A seasonal high water table is the main limitation to farm use. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw-4.

Bono Series

The Bono series consists of nearly level, very poorly drained soils. These soils formed in clayey lacustrine material. They are in depressions on the Defiance Moraine and between beach ridges.

In a representative profile of a Bono silty clay loam that is cultivated, the plow layer is black silty clay loam 9 inches thick. The subsoil is 21 inches thick. The upper part is 6 inches of black silty clay mottled with dark brown; the middle part is 10 inches of dark-gray silty clay mottled with brown and dark yellowish brown; and the lower part is 5 inches of dark-gray silty clay loam mottled with dark yellowish brown. The substratum, which begins at a depth of 30 inches and extends to a depth of 60 inches or more, is gray silty clay that also is mottled dark yellowish brown.

Runoff is slow on Bono soils, and water ponds in the depressions. These soils are saturated with water for extended periods and are slow to warm up and dry out in spring unless adequately drained. Permeability is slow. Gray color and mottling in the subsoil are indicators of natural wetness. When adequately drained these soils have a deep root zone and high available water capacity. They commonly are neutral to mildly alkaline in the root zone.

Bono soils are used primarily for corn and soybeans. Small grain and hay are less extensively grown.

Representative profile of Bono silty clay loam in a cultivated field in Blanchard Township, SE¼SW¼ sec. 14, T. 1 N., R. 8 E.:

Ap—0 to 9 inches, black ((10YR 2/1) silty clay loam; strong, very fine and fine, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

B21g—9 to 15 inches, black (10YR 2/1) silty clay that has a few, fine, distinct, dark-brown (10YR 4/3) mottles; weak, medium, prismatic structure parting to strong, fine and medium, subangular blocky; firm; neutral; clear, wavy boundary.

B22g—15 to 25 inches, dark-gray (10YR 4/1) silty clay that has many, medium, distinct, brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic, structure parting to moderate, medium, subangular blocky; very firm; black (10YR 2/1) organic coatings on vertical ped faces and in root channels; neutral; gradual, wavy boundary.

B3g—25 to 30 inches, dark-gray (10YR 4/1) silty clay that has many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; very firm; black (10YR 2/1) organic coatings on vertical ped faces and in root channels; mildly alkaline; clear, wavy boundary.

C—30 to 60 inches, gray (10YR 5/1) silty clay that has many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; very firm; moderately alkaline, calcareous.

The solum ranges from 25 to 45 inches in thickness. The B horizon is neutral in the upper part and gradually increases with depth to mildly alkaline. The Ap horizon has a hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 0 to 2. The B21g horizon has a hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 0 or 1. The B22g and B3g horizons have a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 0 to 1. They are mottled with a hue of 10YR, value of 4 to 6, and chroma of 2 to 4. These horizons are silty clay or clay in texture. The C horizon has a hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 0 to 2. The texture ranges from silty clay loam to clay.

Bono soils are the very poorly drained members of a drainage sequence that includes the moderately well drained Lucas soils, the somewhat poorly drained Fulton soils, and the very poorly drained Toledo soils. Bono soils generally are adjacent to Toledo soils. The dark-colored A horizon is thicker in the Bono soils than in the Toledo soils.

Bono silty clay loam (Bs).—This nearly level soil is in small oval depressions. Most areas are surrounded by Toledo soils, which occupy slightly higher positions. These areas have no natural surface drainage outlets.

Included with this soil in mapping were Toledo soils on the slightly higher outer perimeters of some areas mapped as this soil. On the moraine in the eastern part of the county, some areas of soils are underlain by glacial till at a depth of 4 to 6 feet.

Seasonal wetness is a major limitation if this soil is used for farming. Seasonal wetness is also a limitation to most nonfarm uses. Capability unit IIIw-2.

Broughton Series

The Broughton series consists of gently sloping to steep, moderately well drained soils. These soils formed in weakly laminated lacustrine clay. They are gently sloping to sloping on the lake plain and are steep on the sides of valleys where streams flow through the plain.

In a representative profile of a Broughton silty clay loam that is cultivated. the plow layer is brown silty clay loam 6 inches thick. The subsoil is 16 inches thick. The upper part is 6 inches of dark yellowish-brown clay mottled with pale brown; the middle part is 6 inches of dark yellowish-brown clay mottled with gray; and the lower part is 4 inches of yellowish-brown clay mottled with gray. The substratum, which begins at a depth of 22 inches and extends to a depth of 60 inches or more, is dark-gray clay mottled with dark yellowish brown.

Runoff is moderate to rapid on Broughton soils, and permeability is very slow. These soils are saturated for short periods, mostly in spring, which delays tillage. Available water capacity is low to medium. Although the clayey subsoil restricts root penetration, most annual crops develop roots to a moderate depth. These soils are medium acid to neutral in the most acid part of the root zone.

The gently sloping Broughton soils are used for corn, soybeans, small grain, and hay. Sloping areas are used mostly for small grain and hay crops. Steeper areas commonly are used for pasture or woodland.

Representative profile of Broughton silty clay loam, 2 to 6 percent slopes, in a cultivated field in Monroe Township, SE¼NE¼ sec. 15, T. 2 N., R. 5 E.:

Ap—0 to 6 inches, brown (10YR 5/3) silty clay loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B21t—6 to 12 inches, dark yellowish-brown (10YR 4/4) clay that has few, fine, distinct, pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky structure; very firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; slightly acid; diffuse, irregular boundary.

B22t—12 to 18 inches, dark yellowish-brown (10YR 4/4) clay that has common, medium, distinct, gray (10YR 5/1) mottles; weak, medium and coarse, subangular blocky structure; very firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical and horizontal ped faces and along some root channels; neutral; abrupt, wavy boundary.

B3t—18 to 22 inches, yellowish-brown (10YR 5/4) clay that has many, medium, distinct, gray (10YR 6/1) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; thin, continuous, grayish-brown (10YR 5/2) clay films along some root channels; mildly alkaline, calcareous; clear, wavy boundary.

C—22 to 60 inches, dark gray (10YR 4/1) clay that has many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; extremely firm; mildly alkaline, calcareous.

The solum ranges from 15 to 22 inches in thickness. Depth to carbonates ranges from 15 to 20 inches. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 to 5. The texture is silty clay loam or clay. The Bt horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Mottles have a hue of 10YR, value of 4 to 6, and chroma of 1 to 3. Reaction is medium acid to neutral in the upper part of the B horizon, and it gradually increases with depth to mildly alkaline and calcareous.

Broughton soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Roselms soils and the very poorly drained Paulding soils. Broughton soils are similar to Lucas and St. Clair soils in natural drainage, but they have a higher clay content in the B and C horizons than those soils.

Broughton silty clay loam, 2 to 6 percent slopes (BtB).—This soil is in both oval and long, narrow areas, most of which are adjacent to the upper part of waterways. A profile of this soil is described as representative for the series. Slopes are relatively short, and most slopes are 2 to 3 percent.

Included with this soil in mapping were spots of soils that have a silt loam surface layer and other spots of soils where the surface layer is moderately eroded. Also included were spots of Roselms soils.

If this soil is used for farming, erosion is a severe hazard. Although drainage generally is not a concern, seep spots occur in a few places. Very slow permeability is a limitation to most nonfarm uses. Capability unit IIIe-2.

Broughton clay, 2 to 6 percent slopes, moderately eroded (BuB2).—This soil is adjacent to natural drainageways. Most areas are long and narrow; however, a few are oval. Slopes are relatively short, and most of them are slightly less than 6 percent. This soil has a profile similar to the one described as representative for the series, but it has a higher content of clay in the surface layer. The present plow layer is a mixture of the material originally in the surface layer and that in the upper part of the subsoil. This soil needs more careful management for growing plants than the less eroded Broughton soils, because it has a lower capacity to absorb and supply moisture to plants. Because of the clay texture of the surface layer, this soil is difficult to cultivate and good seedbeds are difficult to prepare.

Included with this soil in most mapped areas were spots of soils that have a silty clay loam or silt loam surface layer and spots where slope ranges from 6 to 12 percent.

Further erosion is a severe hazard in farmed areas. Very slow permeability is a limitation to many nonfarm uses. Capability unit IIIe-2.

Broughton clay, 6 to 12 percent slopes, moderately eroded (BuC2).—This soil dominantly has short slopes. It is on valley sides along streams that flow through the lake plain. Most areas are small and long and narrow. Except for a higher content of clay in the surface layer, this soil has a profile similar to the one described as representative for the series. The present plow layer is a mixture of the material originally in the surface layer and that in the upper part of the subsoil. Because of the clay texture of the surface layer, this soil is difficult to cultivate and good seedbeds are hard to prepare. This condition is further aggravated by erosion.

Included with this soil in most mapped areas were spots of severely eroded soils where all of the original surface layer has been removed by erosion.

Further erosion is a very severe hazard if this soil is used for farming. Very slow permeability and slope are limitations to many nonfarm uses. Capability unit IVe-1.

Broughton clay, 12 to 18 percent slopes, moderately eroded (BuD2).—This soil has short slopes, and it is on valley sides adjacent to streams. The overall thickness of the surface layer and the subsoil is less than that in the profile described as representative for the series. This soil requires more careful management for growing plants than the less eroded Broughton soils, because it has a lower capacity to absorb and supply water to plants.

Included with this soil in mapping were spots of severely eroded soils where all of the original surface layer has been removed by erosion. Also included were spots of steeper soils.

The hazard of further erosion is very severe if this soil is bare of vegetation. This soil is suited to pasture or trees. Slope is a limitation to many nonfarm uses. Capability unit VIe-1.

Broughton clay, 18 to 25 percent slopes, severely eroded (BuE3).—This soil is on the breaks of valley sides that are adjacent to streams. The overall thickness of the surface layer and the subsoil is less than that in the profile described as representative for the series. This soil is more difficult to manage for growing plants than the less eroded Broughton soils, because it has a lower capacity to absorb and supply water to plants. In several narrow areas the soils have a slope of more than 25 percent. These are shown on the soil map as escarpments. The use of farm machinery is limited by the steep slopes in many areas.

Included in mapping were severely eroded spots of soils where all the original surface layer has been removed by erosion.

Further erosion is a very severe hazard if this soil is bare of vegetative cover. This soil is suited to pasture or trees. Steepness of slope is a limitation to many nonfarm uses. Capability unit VIe–1.

Clay Pits

Clay pits (Cp) is made up of excavated areas from which the original surface layer and subsoil have been removed, primarily for use in making clay tile for drains. The soil material in this land type commonly is calcareous. Because the content of organic matter and available water capacity are low, it is poorly suited to most plants. Bare areas are subject to erosion and are a source of siltation. Grasses and trees that can tolerate the low available moisture capacity and other unfavorable properties of the soil are suitable for seeding and planting. Some of the pits are used as shallow ponds for recreation and wildlife (fig. 3). Not in a capability unit.

Colwood Series

The Colwood series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed at the bottom of former lakes in stratified fine sand and silt that contains some clay material. They are on the lake plain, commonly adjacent to sandy soils.

In a representative profile of a Colwood loam that is cultivated, the plow layer is very dark-gray loam. The subsoil, between a depth of 9 and 13 inches, is very dark grayish-brown loam; between a depth of 13 and 22 inches it is gray loam mottled with yellowish brown; and between a depth of 22 and 45 inches the subsoil is light brownish-gray fine sandy loam mottled with yellowish brown. The substratum, which begins at a depth of 45 inches and extends to a depth of 60 inches or more, is gray, stratified fine sand, silt, and clay that is mottled yellowish brown.

Colwood soils have a seasonal high water table. Runoff is slow, and water ponds in depressions. Permeability is moderate, and available water capacity is high. Where these soils are adequately drained, the root zone is deep. They are commonly neutral in reaction.

Colwood soils are used primarily for growing corn, soybeans, small grain, and hay.

Figure 3.—Abandoned clay pit being developed as a shallow-water area for wildlife.

Representative profile of Colwood loam in a cultivated field in Perry Township, NW¼NW¼ sec. 4, T. 1 N., R. 5 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; very friable; many roots; neutral; abrupt, smooth boundary.

A12—9 to 18 inches, very dark grayish-brown (10YR 3/2) loam; weak and moderate, fine and medium, subangular blocky structure; very friable; many roots; neutral; clear, wavy boundary.

B21g—18 to 22 inches, gray (10YR 5/1) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, and medium, subangular blocky structure; friable; many roots; neutral; diffuse, wavy boundary.

B22g—22 to 45 inches, light brownish-gray (10YR 6/2) fine sandy loam; few, fine, faint yellowish-brown (10YR 5/6) mottles; friable; weak, fine, subangular blocky structure; neutral; gradual, wavy boundary.

C—45 to 60 inches, gray (10YR 5/1) stratified fine sand and silt that has thin strata of clayey material; few fine, distinct, brownish-yellow (10YR 6/6) and light yellowish-brown (10YR 6/4) mottles; firm; mildly alkaline, calcareous.

The solum ranges from 40 to 50 inches in thickness; carbonates commonly occur at the same depth. The A and B horizons are typically neutral, but in some profiles the Ap horizon is slightly acid, and in others the lower part of the B horizon is mildly alkaline. In the Ap and A1 horizons, the colors include very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), black (10YR 2/1), and very dark brown (10YR 2/2). In the B2 horizon, the colors are gray (10YR 5/1), light brownish gray (10YR 6/2), and grayish brown (10YR 5/2). Texture in the B2 horizon includes fine sandy loam, loam, silt loam, and light silty clay loam.

Colwood soils are the very poorly drained members of a drainage sequence that includes the somewhat poorly drained Kibbie soils and the moderately well drained Tuscola soils. Colwood soils formed in finer textured material than Millgrove soils. Colwood soils formed in coarser textured material than the Lenawee soils.

Colwood loam (Cw).—This soil is nearly level. Most areas are long and narrow and are near beach ridges and terraces.

Included with this soil in mapping were spots of soils that have a surface layer of fine sandy loam and spots of the finer textured Lenawee soils and the coarser textured Millgrove soils.

Seasonal wetness is a moderate limitation if this soil is used for farming. Wetness is a limitation to most nonfarm uses. Capability unit IIw–5.

Cut and Fill Land

Cut and fill land (Cx) consists of areas where the soil material has been disturbed, moved, or leveled, or of areas that have been artificially filled with earth or trash, or both, in such a manner as to alter the original soil profile. The soil material in many areas of this land type is made up of a mixture of parent material and material from the original surface layer and subsoil. Some of these areas have been leveled and graded and are used for cultivated crops. Onsite investigations of Cut and fill land are needed before suitability for most uses can be determined.

In areas where soil material has been removed, this land type is generally similar to the material in the substratum of the adjacent soils. In fill or disposal areas, the soil material has more variable characteristics because it commonly consists of varying kinds and amounts of material from other sources, including the subsoil and substratum materials of nearby soils.

The soil material in this land type generally is poor for plant growth. It is normally calcareous, especially in areas where the source of material was from soils underlain by deposits of glacial till or lacustrine material. Available water capacity and the content of organic matter are low, and most areas are susceptible to erosion if they are not protected. Instability of the soil material causes gullying and siltation.

Where a cover of plants is to be established and maintained, resurfacing areas of this land type with favorable soil material provides a more suitable root zone. Grasses and trees that can tolerate the adverse characteristics of the soil material are needed to help prevent erosion and siltation. Most of these areas would then be suitable for wildlife habitat or for development for recreational purposes. Not placed in a capability unit.

Defiance Series

The Defiance series consists of nearly level soils that are somewhat poorly drained. These soils formed in fine-textured alluvium. They are along the more sluggish, slow-flowing streams.

In a representative profile of a Defiance silty clay loam that is cultivated, the plow layer is dark-gray silty clay loam about 7 inches thick. The subsoil is 21 inches thick. The uppermost 4 inches of it is grayish-brown heavy clay loam mottled with yellowish brown; the next 9 inches is grayish-brown clay mottled with yellowish brown; and the lowermost 8 inches is yellowish-brown clay mottled with light brownish gray. The substratum begins at a depth of 28 inches and reaches a depth of 60 inches or more. It consists of grayish-brown silty clay mottled with yellowish brown.

Defiance soils are subject to frequent flooding in winter and in spring. Runoff is slow on these soils, and permeability is slow. The grayish colors and mottling in the subsoil indicate natural wetness. Available water capacity is high. If adequately drained, these soils have a deep root zone. The root zone of most of these soils is neutral in reaction.

Defiance soils are used primarily for corn and soybeans.

Representative profile of Defiance silty clay loam in a cultivated field in Monterey Township, NE¼NE¼ sec. 24, T. 1 S., R. 4 E.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) silty clay loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B1g—7 to 11 inches, grayish-brown (10YR 5/2) heavy clay loam; many, fine and medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine and medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

B21g—11 to 20 inches, grayish-brown (10YR 5/2) clay; many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very firm; neutral; diffuse, wavy boundary.

B22g—20 to 28 inches, yellowish-brown (10YR 5/4) clay; many, fine and medium, distinct, light brownish-gray (2.5Y 6/2) mottles; weak, medium and coarse, subangular blocky structure; very firm; neutral; diffuse, irregular boundary.

Cg—28 to 60 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; firm; stratified with thin layers of silty clay loam, loam, silt loam, and sandy loam; neutral.

The solum ranges from 26 to 42 inches in thickness. The A and B horizons range from slightly acid to mildly alkaline. The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2). The B1g and B21g horizons are grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). Mottles in the B1g and B21g horizons have a hue of 10YR, value of 4 or 5, and chroma of 4 to 8. The B horizon is heavy clay loam, clay, silty clay loam, or silty clay. The C horizon is silty clay or clay.

Defiance soils are the somewhat poorly drained members of a drainage sequence that includes the very poorly drained Wabasha soils. Defiance soils formed in heavier textured material than Shoals soils. They have more gray colors and mottles than Genesee soils.

Defiance silty clay loam (Df).—This nearly level soil is on flood plains. Most areas of this soil are oval or are in slightly higher areas than the adjacent Wabasha soils. long narrow strips parallel to streams. This soil occupies Runoff is slow and tends to pond in depressional areas. Included in mapping were spots of soils that have a silt loam surface layer.

Wetness is a severe limitation if this soil is used for farming. Flooding is a limitation to most nonfarm uses. Capability unit IIIw-3.

Del Rey Series

The Del Rey series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in lacustrine silty clay loam and clay loam that is stratified with thin layers of sandy material. They are mostly on the lake plain. A lesser acreage is on the Defiance moraine.

In a representative profile of a Del Rey silt loam that is cultivated, the plow layer is grayish-brown silt loam 8 inches thick. The subsoil is 30 inches thick. Between a depth of 8 and 14 inches it is grayish-brown light silty clay loam mottled with dark yellowish brown; between a depth of 12 and 22 inches it is grayish-brown heavy silty clay loam mottled with yellowish brown; between a depth of 22 and 34 inches it is yellowish-brown heavy silt clay loam mottled with gray; and between a depth of 34 and 38 inches it is yellowish-brown silty clay loam mottled with gray. The substratum begins at a depth of 38 inches and extends to a depth of 60 inches or more. It consists of yellowish-brown, stratified light silty clay loam mottled with gray.

Runoff is slow to moderate on Del Rey soils, and permeability is slow. These soils have a seasonal high water table. The grayish colors and mottling indicate natural wetness. Available water capacity is high. The root zone is deep. It generally is slightly acid.

Del Rey soils are used primarily for corn, soybeans, small grain, and hay.

Representative profile of Del Rey silt loam, 0 to 2 percent slopes, in a cultivated field in Blanchard Township, SE¼SE¼ sec. 28, T. 1 N., R. 8 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; moderate, fine and medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B1g—8 to 14 inches, grayish-brown (10YR 5/2) light silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine and medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B21tg—14 to 22 inches, grayish-brown (10YR 5/2) heavy silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical ped faces; slightly acid; diffuse, wavy boundary.

B22tg—22 to 34 inches, yellowish-brown (10YR 5/4) heavy silty clay loam; many, medium, distinct, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm; thin, patchy, gray (10YR 5/1) clay films on vertical and horizontal ped faces; slightly acid; abrupt, wavy boundary.

B3t—34 to 38 inches, yellowish-brown (10YR 5/6) silty clay loam; many, medium, distinct, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm; mildly alkaline; clear, wavy boundary.

C—38 to 60 inches, yellowish-brown (10YR 5/4) stratified light silty clay loam; many, medium, distinct, gray (10YR 6/1) mottles; massive; friable; mildly alkaline, calcareous.

Depth to carbonates ranges from 30 to 40 inches. The Ap horizon has a color of 10YR 4/2 or 10YR 5/2 and a texture of silt loam or loam. The B1g and B21tg horizons have a hue of 10YR, value of 4 or 5, and a chroma of 1 or 2. Their mottles have a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The B22tg horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 to 6. This horizon is heavy silty clay loam or clay loam in texture and slightly acid to neutral in reaction. The B3 horizon is not present in some profiles. The C horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is mottled with a hue of 10YR, value of 5 or 6, and chroma of 1 or 2. It ranges from silt loam to light silty clay loam.

Del Rey soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Shinrock soils and the very poorly drained Lenawee soils. Del Rey soils are similar to Fulton and Kibbie soils in that they are somewhat poorly drained and formed in lacustrine sediment. However, they differ from the Fulton soils in being coarser textured in the B and C horizons. Del Rey soils differ from Kibbie soils by having finer textured B and C horizons.

Del Rey loam, 0 to 2 percent slopes (DgA).—This soil is in small, oval areas. It has a profile similar to the one described as representative for the series, but the surface layer is sandier. This soil is thus easier to cultivate than Del Rey silt loam, 0 to 2 percent slopes.

Included with this soil in many mapping areas were spots of coarser textured Kibbie soils and spots of Haskins soils that are underlain by fine-textured material. Also included were spots of soils that have a slope of 2 to 6 percent.

Seasonal wetness is a moderate limitation if this soil is used for farming. Seasonal wetness also is a limitation to many nonfarm uses. Capability unit IIw-2.

Del Rey silt loam, 0 to 2 percent slopes (DlA).—This soil is in broad areas on slight rises of the lake plain, commonly near Lenawee soils. It also is on the moraine in the east-central part of the county, generally near Toledo soils. Most areas of this soil are oval in shape, but on the moraine the areas are elongated and are dominantly oriented north and south. A profile of this soil is described as representative for the series.

Included with this soil in many mapped areas were spots of finer textured Fulton soils. In other areas, spots of Lenawee soils were also included.

Seasonal wetness is a moderate limitation if this soil is used for farming. Seasonal wetness is also a limitation to many nonfarm uses. Capability unit IIw-2.

Del Rey silt loam, 2 to 6 percent slopes (DlB).—This soil generally is adjacent to the valley sides of streams and on moraines or lake plains.

Included with this soil in mapping in most areas were spots of soils that have slopes of less than 2 percent. Also included were spots of moderately well drained Shinrock soils and spots of coarser textured Kibbie soils.

Seasonal wetness is a moderate limitation if this soil is used for farming. Also, erosion is a hazard, particularly where slopes are longer or steeper. Wetness is a limitation to many nonfarm uses. Capability unit IIw–2.

Del Rey-Fulton silt loams, 1 to 6 percent slopes (DmB).—This complex is in long, narrow areas on the moraines. It consists of Del Rey and Fulton soils in areas so small and intermingled that it is not possible to show each soil separately on the soil map. Del Rey soils make up about 40 percent of the complex and Fulton soils about 40 percent. The remaining 20 percent includes spots of the coarser textured Kibbie or Haskins soils or spots of Lucas or Shinrock soils.

Seasonal wetness is a moderate limitation if these soils are used for farming. Also, erosion is a hazard, particularly where slopes are longer and steeper. Seasonal wetness is a limitation to most nonfarm uses. Capability unit IIw–2.

Digby Series

The Digby series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in loamy glacial material underlain by sand and gravel that contain varying quantities of silt and clay. Digby soils are on beach ridges, outwash plains, and stream terraces.

In a representative profile of a Digby soil that is cultivated, the plow layer is dark grayish-brown loam 9 inches thick. The subsoil is 27 inches thick. From a depth of 9 inches to a depth of 18 inches, it is grayish-brown loam mottled with yellowish-brown; between a depth of 18 and 24 inches, it is grayish-brown sandy clay loam mottled with yellowish brown; and between a depth of 24 and 36 inches, it is yellowish-brown sandy clay loam mottled with grayish brown. The substratum extends from a depth of 36 inches to 60 inches or more and is gray, stratified fine gravel and sand.

Digby soils have moderate permeability and slow runoff. They have medium available water capacity. Where these soils are adequately drained, the root zone is deep. It is strongly acid to mildly alkaline.

Digby soils are cultivated and are used primarily for corn, soybeans, and small grain.

Representative profile of Digby loam, 0 to 2 percent slopes, in a cultivated field in Sugar Creek Township, SW¼SE¼ sec. 6, T. 2 S., R. 6 E.:

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

B1t—9 to 18 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine and medium, subangular blocky structure; friable; few fine pebbles; strongly acid; gradual wavy boundary.

B21t—18 to 24 inches, grayish-brown (10YR 5/2) sandy clay loam; many, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical and horizontal ped faces; 5 percent pebbles; strongly acid; diffuse, wavy boundary.

B22t—24 to 36 inches, yellowish-brown (10YR 5/4) sandy clay loam; common, medium, distinct, dark grayish-brown (10YR 4/2) mottles and many, medium, yellowish-brown (10YR 5/8) mottles; weak, medium, and coarse, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical ped faces; 10 percent pebbles; medium acid grading to neutral in lower part; clear, irregular boundary.

C—36 to 60 inches, gray (10YR 5/1) stratified fine gravel and sand; single grain; loose; mildly alkaline, calcareous.

The solum ranges from 24 to 40 inches in thickness. Depth to the mildly alkaline, calcareous material ranges from 24 to 48 inches, but it is generally at a depth of about 34 inches. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The B1t horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The texture is clay loam or sandy clay loam. The B21t horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. Its mottles have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. Its texture is sandy clay loam, clay loam, or sandy clay. The B22t horizon has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The mottles in this horizon have a hue of 10YR value of 4 or 5, and chroma of 1 to 8. The texture is sandy clay loam or clay loam.

Digby soils are the somewhat poorly drained soils in a drainage sequence with the well drained Belmore soils, the moderately well drained Haney soils, and the very poorly drained Millgrove soils. Digby soils are lighter colored than the Millgrove soils. Their B horizon is grayer and more mottled than that of the Bellmore and Haney soils. Digby soils contain more fine gravel than Kibbie soils. They are similar to the Haskins soils but lack the fine-textured substratum.

Digby loam, 0 to 2 percent slopes (DnA).—This soil is on low-lying beach ridges and on slightly elevated stream terraces. Generally, the areas are long and narrow and they conform to the winding patterns of the beach ridges and terraces. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of soils that have a slightly coarser surface layer than this soil and spots of soils that have a surface layer of silt loam.

A seasonal high water table is a moderate limitation to farm use. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–2.

Digby loam, 2 to 6 percent slopes (DnB).—This soil generally is near the base of the major beach ridges, but it also is on stream terraces and outwash plains. On the beach ridges and stream terraces, the areas are dominantly elongated and are adjacent to areas of Haskins, Millgrove, Mermill, or Haney soils. On the outwash plains the areas generally are oval and are adjacent to areas of Haskins, Blount, Nappanee, or St. Clair soils.

Included with this soil in mapping were areas of soils where the surface layer is sandier than that of this soil, and small areas of Haskins loam where a contrasting clayey material is at a depth of less than 40 inches. Also included were a few small areas of soils that have a gravelly surface layer.

A seasonal high water table is a moderate limitation to farm use. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–2.

Digby Series, Moderately Shallow Variant

The Digby series, moderately shallow variant, consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy glacial material underlain by limestone bedrock at a depth of 20 to 30 inches. They are on a low terrace along Riley Creek in Riley Township.

In a representative profile of a Digby loam, moderately shallow variant, that is cultivated, the plow layer is dark grayish-brown loam 8 inches thick. The next layer is 2 inches of light yellowish-brown loam mottled with grayish brown. The subsoil is at a depth of 10 inches and extends to a depth of 28 inches. It is grayish-brown clay loam mottled with yellowish brown. The subsoil rests on limestone bedrock.

Digby soils, moderately shallow variant, have moderate permeability, and low available water capacity. The root zone is moderately deep. It is medium acid to slightly acid.

These soils are cultivated and are used mainly for corn, soybeans, and small grain.

Representative profile of Digby loam, moderately shallow variant, 0 to 2 percent slopes, in a cultivated field in Riley Township, SW¼NE¼ sec. 29, T. 1 S., R. 8 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; 5 percent pebbles; slightly acid; abrupt, smooth boundary.

B&A—8 to 10 inches, light yellowish-brown (10YR 6/4) loam; many, fine, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; 5 percent pebbles; slightly acid; clear, smooth boundary.

B1t—10 to 28 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak to moderate fine blocky structure; firm; thin, patchy, gray (10YR 5/1) clay films on vertical and horizontal ped faces; 10 percent pebbles; slightly acid; abrupt, smooth boundary.

R—28 inches, limestone bedrock.

Depth to the underlying bedrock ranges from 20 to 30 inches, but it is generally about 22 inches thick. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The Bt horizon matrix color is in a hue of 10YR or 7.5 YR, value of 4 to 6, and chroma of 1 or 2. Mottles in this horizon have a hue of 10YR, value of 4 or 5, and chroma of 4 to 8. The texture is clay loam or sandy clay loam.

This soil is adjacent to the Shoals silt loam, moderately shallow variant, which is on flood plains. It is also adjacent to the moderately well drained Rawson soils.

Digby loam, moderately shallow variant, 0 to 2 percent slopes (DoA).—This soil makes up an area of about 30 acres along the east side of Riley Creek between the village of Pandora and the Allen County line. In places bedrock is at a depth of 12 to 20 inches. This soil is subject to occasional flooding. It is somewhat droughty in dry periods because of shallowness.

A seasonal high water table is a moderate limitation to farm use. Seasonal wetness and shallowness to bedrock are limitations to many nonfarm uses. Capability unit IIw-2.

Fulton Series

The Fulton series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in clayey lacustrine material. They are in the slightly higher areas of the lake plain.

In a representative profile of a Fulton soil that is cultivated, the plow layer is dark grayish-brown silty clay loam about 7 inches thick. The next layer is 2 inches of light-gray silty clay loam mottled with yellowish brown. The subsoil is 20 inches thick. It is grayish-brown silty clay that is mottled mostly with yellowish brown. The substratum, which begins at a depth of 29 inches and extends to a depth of 60 inches or more, is yellowish-brown silty clay.

Fulton soils have slow permeability and medium available water capacity. They are saturated with water for significant periods in winter and in spring. They dry out slowly in spring unless artificially drained. The growth of roots is restricted to a moderate depth by the clayey subsoil. In the upper part of the root zone, the soil is medium acid to neutral.

Fulton soils are used mostly for corn, soybeans, and small grain.

Representative profile of Fulton silty clay loam, 0 to 2 percent slopes, in a cultivated field in Greensburg Township, SE¼NE¼ sec. 24, T. 1 N., R. 6 E., laboratory No. PT-26:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; many roots; neutral; abrupt, smooth boundary.

B&A—7 to 9 inches, light-gray (10YR 6/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; common roots; slightly acid; clear, wavy boundary.

B21tg—9 to 15 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles and a few, fine, prominent, yellowish-red (5YR 5/6) mottles; strong, medium and coarse, subangular blocky structure parting to moderate, fine, subangular blocky; firm; common roots; thin, patchy grayish-brown (10YR 5/2) clay films on vertical ped faces; medium acid; clear, wavy boundary.

B22tg—15 to 25 inches, grayish-brown (10YR 5/2) silty clay; many, large, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure parting to moderate, coarse, subangular blocky; very firm; few roots; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal ped faces; slightly acid; clear, wavy boundary.

B3g—25 to 29 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; few roots; few, small, black (10YR 2/1) oxide concretions; light brownish-gray (10YR 6/2) lime coatings on some ped faces; mildly alkaline, calcareous; clear, wavy boundary.

C—29 to 60 inches, yellowish-brown (10YR 5/6) silty clay; many, medium, distinct, gray (10YR 5/1) mottles; weak, coarse, prismatic structure; very firm; few, small, black (10YR 2/1) oxide concretions; light-gray (10YR 6/1) lime coatings on ped faces; mildly alkaline, calcareous.

The solum ranges from 24 to 36 inches in thickness, but it is generally about 28 inches thick. The Ap horizon is dark grayish-brown (10YR 4/2) or grayish-brown (10YR 5/2) silty clay loam or loam. The B2 and B3 horizons have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Their mottles have a hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 3 to 6. The texture is silty clay or clay. The C horizon has a hue of 10YR, value of 4 to 6, and chroma of 3 to 6. The mottles are 10YR in hue, 4 to 6 in value, and 1 or 2 in chroma. The C horizon is mildly alkaline and calcareous.

Fulton soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Lucas soils, the very poorly drained Toledo soils, and the very dark colored and very poorly drained Bono soils. Fulton soils formed in clayey lacustrine material, whereas Nappanee soils formed in clayey glacial till. Fulton soils have finer textured B and C horizons than the Del Rey soils. They have coarser textured B and C horizons than the Roselms soils.

Fulton loam, 0 to 2 percent slopes (FtA).—This soil commonly is near the Haskins soils in areas where there is a thin mantle of loamy overwash on clayey lacustrine sediment. It has a profile similar to the one described as representative for the series, but its surface layer has a higher content of sand and is as much as 14 inches thick in places. The surface layer commonly is 10 to 12 inches thick. This soil is easier to cultivate and is less subject to crusting than Fulton silty clay loam, 0 to 2 percent slopes.

Included with this Fulton soil in mapping were small areas of gently sloping soils and spots of soils that have a siltier surface layer than this soil. Also included were some spots of the coarser textured Haskins and Del Rey soils.

A seasonal high water table is a severe limitation to farm use. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIIw–1.

Fulton silty clay loam, 0 to 2 percent slopes (FuA).—This soil commonly is on slight rises on the lake plain near the Toledo soils. It also occurs in the east-central part of the county near the Del Rey and Kibbie soils. Areas of this soil commonly are oval or irregular in shape. In the east-central part of the county, the areas are relatively small elongated ovals, the long axis of which is oriented north and south. A profile of this soil is described as representative for the series.

Included with this soil in mapping were small spots of gently sloping soils and a few long, narrow spots of the wetter Toledo soils.

A seasonal high water table is a severe limitation to farm use. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIIw–1.

Fulton silty clay loam, 2 to 6 percent slopes (FuB).—This soil is on rises on the lake plain and along drainageways. Areas of this soil generally are oval in shape on the lake plains, but they are elongated or irregular in shape near the drainageways. Slopes are typically short and mostly 2 to 4 percent. Surface water moves away more readily on this soil than it does on Fulton silty clay loam, 0 to 2 percent slopes.

Included with this soil in mapping on a few of the higher rises were moderately eroded soils. Also included were a few areas of soils that have a silt loam surface layer.

A seasonal high water table is a severe limitation to farm use. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIIw–1.

Fulton silty clay loam, gravelly substratum, 0 to 2 percent slopes (FvA).—This soil commonly is on some of the stream terraces and second bottoms that are adjacent to the Auglaize and Blanchard Rivers. Also, small areas are near some of the other larger streams in the county. This soil commonly is adjacent to the Digby soils or areas of alluvial soils. It has a profile similar to the one described as representative for the series, but it has a gravelly, rather than a clayey, substratum, and the combined thickness of the surface layer and the subsoil commonly is about 10 inches greater. The gravelly substratum ranges from 40 to 60 inches in depth, but it is generally at a depth of 40 to 45 inches.

This soil is flooded occasionally because of its low-lying position; however, its substratum is more permeable than that of other Fulton soils, and it drains more readily.

Included with this soil in mapping were a few spots of soils that have a gravelly substratum at a depth of 35 to 40 inches. Also included were small spots of alluvial soils, mostly Shoals and Sloan, and small spots of the coarser textured Digby soils.

A seasonal high water table is a severe limitation to farm use. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIIw–1.

Genesee Series

The Genesee series consists of nearly level soils that are well drained. These soils formed in stratified, medium-textured, recent alluvium. They are on flood plains at slightly elevated positions on the first bottoms along major streams.

In a representative profile of a Genesee soil that is cultivated, the plow layer is dark-brown silt loam about 8 inches thick. The subsoil is 36 inches thick. It is dark-brown silt loam in the upper 20 inches and dark-brown light silt loam in the lower 16 inches. The substratum, which begins at a depth of 44 inches and extends to a depth of 60 inches or more, is dark-brown, stratified silt loam, loam, silty clay loam, and sandy loam mottled with gray.

Genesee soils are subject to flooding, but they flood less frequently and severely than the alluvial soils at lower positions. Runoff is slow, and permeability is moderate. The available water capacity is high. These soils have a deep root zone and are easy to cultivate. Their root zone is slightly acid to neutral.

Genesee soils are used primarily for corn and soybeans. The hazard of flooding limits the use of these soils for winter and early spring crops such as wheat and oats.

Representative profile of Genesee silt loam in a cultivated field in Jackson Township, SE¼SE¼ sec. 27, T. 1 S., R. 5 E.:

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

B21—8 to 28 inches, dark-brown (10YR 4/3) silt loam; moderate, fine and medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

B22—28 to 44 inches, dark-brown (10YR 4/3) light silt loam; weak, fine, subangular blocky structure, friable; neutral; clear, wavy boundary.

C—44 to 60 inches, dark-brown (10YR 4/3) stratified silt loam, loam, silty clay loam, and sandy loam; common, medium, distinct, gray (10YR 5/1) mottles; massive; very friable; mildly alkaline.

The solum ranges from 30 to 50 inches in thickness but typically it is about 40 inches thick. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The B horizon has a hue of 10YR, value of 3 or 4, and chroma of 3 or 4. Its texture is silt loam, loam, or light silty clay loam. In some profiles gray mottles occur below a depth of 30 inches in the B horizon. The C horizon has a hue of 10YR, value of 4 and 5, and chroma of 3 and 4. Its mottles have a hue of 10YR, a value of 4 to 6, and chroma of 1 and 2.

The solum of this soil is slightly thicker than that in the range defined for the series. Also, free carbonates do not occur within 40 inches of the surface, as indicated in the range defined for the series. These differences do not greatly influence the use or behavior of these soils.

Genesee soils are the well-drained members of a drainage sequence that also includes the somewhat poorly drained Shoals soils and the darker colored and very poorly drained Sloan soils. They are adjacent to these soils in many places.

Genesee silt loam (Gn).—Most of the acreage of this nearly level soil is on the flood plains of the Auglaize, Blanchard, and Ottawa Rivers. This soil also is on flood plains of some of the smaller streams in the county. It generally is in slightly elevated positions on the first bottoms. Most areas of Genesee soils are accessible for farming, but a few isolated areas are difficult to get to.

Included with this soil in mapping were spots of soils that have dark colors extending to a depth of 15 inches. Most of these are on the Blanchard River flood plain. Also included in mapping were areas of moderately well drained soils that are mottled with dark gray in the subsoil.

Other than susceptibility to flooding, limitations to use of this soil for farming are few. Flooding is a limitation to most nonfarm uses. Capability unit I–1.

Gravel Pits

Gravel pits (Gp) consists of open excavations from which the upper layers of the soil have been removed during the mining of the underlying gravelly material. This land type is on gravelly beach ridges and in areas of outwash. The areas generally are near soils of the Belmore and Haney series, which were present in these areas before they were removed to expose the underlying sand and gravel.

Because of the nature of strip mining, soil material in the spoil bank of gravel pits varies within short horizontal distances. This soil material is low in content of organic matter, and it has low available water capacity. These conditions are poor for the growth of most plants.

The soil material in areas that are no longer being mined should be treated so that plants can be established. Grasses and trees that can tolerate the unfavorable soil properties are suitable for seeding and planting. Pond areas are potentially suitable for recreation or wildlife. Not placed in a capability unit.

Haney Series

The Haney series consists of nearly level to gently sloping soils that are moderately well drained. These soils formed in loamy material overlying stratified fine gravel and sand. They are on beach ridges, stream terraces, and outwash plains.

In a representative profile of a Haney soil that is cultivated, the plow layer is dark-brown loam about 9 inches thick. The subsoil is 33 inches thick. The uppermost layer is 8 inches of yellowish-brown clay loam; the next layer is 9 inches of yellowish-brown clay loam mottled with grayish brown; the next is 8 inches of dark-brown sandy clay loam mottled with gray; and the lowermost layer is 8 inches of dark-brown sandy clay loam mottled with dark gray. The substratum begins at a depth of 42 inches and extends to a depth of 60 inches or more. It is gray gravelly loam mottled with yellowish brown.

Haney soils have moderate permeability and medium available water capacity. Runoff is slow to moderate. The root zone is deep. It ranges from strongly acid in the upper part to mildly alkaline in the lower part.

Haney soils commonly are used for corn, soybeans, and small grain.

Representative profile of Haney loam in a cultivated field in Sugar Creek Township, SE¼SE¼ sec. 1, T. 2 S., R. 6 E.:

Ap—0 to 9 inches, dark-brown (10YR 4/3) loam; moderate, medium, granular structure; very friable; 5 percent pebbles; slightly acid; abrupt, smooth boundary.

B1t—9 to 17 inches, yellowish-brown (10YR 5/4) light clay loam; few, medium, faint, brown (10YR 5/3) and dark yellowish-brown (10YR 4/4) mottles; weak and moderate, fine and medium, subangular blocky structure; friable; thin, patchy, dark-brown (10YR 4/3) clay films on vertical ped faces; 5 percent pebbles; medium acid; clear, wavy boundary.

B21t—17 to 26 inches, yellowish-brown (10YR 5/4) clay loam; few, fine, distinct, dark-brown (10YR 4/3) and dark grayish-brown (10YR 4/2) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, brown (10YR 5/3) clay films on vertical and horizontal ped faces; 10 percent pebbles; medium acid; diffuse, wavy boundary.

B22t—26 to 34 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; common, medium, distinct, gray (10YR 5/1) mottles; weak and moderate, fine and medium, subangular blocky structure; firm, thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal ped faces; 10 percent pebbles; slightly acid; clear, wavy boundary.

B3t—34 to 42 inches, dark-brown (7.5YR 4/4) sandy clay loam; common, medium, distinct, dark-gray (N 4/0) mottles; weak, medium, subangular blocky structure; firm; thin, patchy, gray (10YR 5/1) clay films on vertical ped faces; 10 percent pebbles; mildly alkaline, calcareous; diffuse, wavy boundary.

C—42 to 60 inches, gray (10YR 5/1) gravelly loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; massive; loose; 20 percent pebbles; mildly alkaline, calcareous.

The solum ranges from 26 to 44 inches in thickness, but it is generally about 35 inches thick. Gray mottles are at a depth of 16 to 26 inches. The A horizon is neutral to medium acid. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Its texture is loam or sandy loam. The B horizon is strongly acid to slightly acid in the upper part and it ranges from slightly acid to mildly alkaline in the lower part. The B1t horizon has a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. Its texture is loam, light clay loam, fine sandy loam, or sandy clay loam. The B2t horizon has a hue of 10YR or 7.5YR and a value and chroma of 4 to 6. Its mottles have a hue of 10YR, value of 4 to 6, and chroma of 1 to 3. Its texture is clay loam, sandy clay loam, sandy clay, or gravelly clay loam. The C horizon is calcareous. It has a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Its mottles have a hue of 10YR or 7.5YR and value and chroma of 4 to 6. Its texture is gravelly loam or gravelly sandy loam.

Haney soils are the moderately well drained members of a drained sequence that includes the well drained Belmore soils, the somewhat poorly drained Digby soils, and the very poorly drained Millgrove soils. Haney soils are similar to Vaughnsville soils, except that Vaughnsville soils are reddish brown. Haney soils have a finer textured B horizon than the Tuscola soils, but the Tuscola soils contain no pebbles. Haney soils are similar to Rawson soils, except that Rawson soils have fine-textured lacustrine material within a depth of 40 inches.

Haney sandy loam, 2 to 6 percent slopes (HaB).—This soil is mainly on stream terraces, outwash plains, and beach ridges on the moraine in the east-central part of the county. Areas generally are elongated and tend to conform to the relief of the local landform. This soil has a profile similar to the one described as representative for the series, but the surface layer has a higher content of sand. It is easier to cultivate than Haney loam, 2 to 6 percent slopes, but is more droughty because of the high content of sand.

Included with this soil in mapping were spots of moderately eroded soils and a few areas of Haney soils that are steeper than this soil.

A moderate hazard of erosion is the major limitation to use. Slope is a limitation to some nonfarm uses. Capability unit IIe–1.

Haney loam, 0 to 2 percent slopes (HdA).—This soil generally is on elevated flats of the beach ridges and stream terraces and in a few small, slightly elevated areas of local outwash. Areas generally are oval and are adjacent to other Haney soils and to Belmore and Digby soils.

Included with this soil in mapping were small spots of gently sloping Haney soils and spots of soils that have a silt loam or sandy loam surface layer.

This soil has no major limitations to farm use nor to most nonfarm uses. Capability unit I–2.

Haney loam, 2 to 6 percent slopes (HdB).—This soil is mainly along the flanks of beach ridges. A few areas are on stream terraces. The areas of this soil commonly are elongated, and they generally conform to the local relief of the beach ridges and stream terraces. A profile of this soil is described as representative for the series.

Included with this soil in mapping were small areas of soils that have a silt loam surface layer and small areas of moderately eroded soils. Also included were small areas of nearly level soils.

A moderate hazard of erosion is the major limitation to use of this soil for farming. Slope is a limitation to some nonfarm uses. Capability unit IIe–1.

Haskins Series

The Haskins series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed partly in loamy material and partly in underlying fine-textured glacial till or fine-textured lacustrine material. They occur on beach ridges, outwash plains, and stream terraces. The underlying, finer textured soil material is at a depth of 20 to 40 inches.

In a representative profile of a Haskins soil that is cultivated, the plow layer is grayish-brown loam 8 inches thick. The subsoil is 27 inches thick. The uppermost layer is 3 inches of brown loam mottled with yellowish brown; the next layer is 5 inches of grayish-brown loam mottled with yellowish brown; the next is 8 inches of grayish brown sandy clay loam mottled with yellowish brown; below this is 6 inches of dark yellowish-brown sandy clay loam mottled with grayish brown and yellowish brown; and the lowermost layer is 5 inches of grayish-brown clay mottled with dark yellowish brown. The substratum, which begins at a depth of 35 inches and extends to a depth of 60 inches or more, is dark grayish-brown clay mottled with dark yellowish brown.

Runoff on Haskins soils is slow to moderate. Permeability is moderate in the upper part of the profile and very slow in the underlying fine-textured material. These soils have a moderately deep root zone and medium available water capacity. They have a seasonal high water table. The root zone commonly is slightly acid to strongly acid in the most acid layer. As the depth increases, this soil becomes less acid and grades to mildly alkaline.

Haskins soils are used primarily for corn, soybeans, small grain, and hay.

Representative profile of Haskins loam, 0 to 2 percent slopes, in a cultivated field in Sugar Creek Township, NE¼SW¼ sec. 5, T. 2 S., R. 6 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) loam; weak, fine and medium, granular structure; very friable; 3 percent fine pebbles; medium acid; abrupt, smooth boundary.

B1—8 to 11 inches, brown (10YR 5/3) loam; few, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; very friable; 3 percent fine pebbles; strongly acid; diffuse, wavy boundary.

B21t—11 to 16 inches, grayish-brown (10YR 5/2) loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; friable; thin, patchy, contrasting, grayish-brown (10YR 5/2) clay films on vertical ped faces; 3 percent fine pebbles; strongly acid; clear, wavy boundary.

B22t—16 to 24 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak and moderate, fine and medium, subangular blocky structure; firm; thin, patchy, contrasting, grayish-brown (10YR 5/2) clay films on vertical ped faces; 3 percent fine pebbles; medium acid; diffuse, wavy boundary.

B23t—24 to 30 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; many, medium, distinct, grayish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical and horizontal ped faces; 3 percent fine pebbles; slightly acid; abrupt, wavy boundary.

IIB3t—30 to 35 inches, grayish-brown (10YR 5/2) clay; many, medium, faint, brown (10YR 5/3) and dark yellowish-brown (10YR 4/4) mottles; weak, medium and coarse, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical ped faces and thin continuous clay films along old root channels in places; neutral; clear, wavy boundary.

IIC1—35 to 60 inches, dark grayish-brown (10YR 4/2) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; very firm; compact glacial till; mildly alkaline, calcareous.

The solum ranges from 26 to 42 inches in thickness, but it commonly extends into the underlying fine-textured material.

The content of fine pebbles is 2 to 10 percent in the Ap horizon and 0 to 20 percent in the B horizon. The Ap horizon is dark grayish-brown (10YR 4/2) or grayish-brown (10YR 5/2) loam or fine sandy loam. Reaction ranges from slightly acid to strongly acid in the upper part of the B horizon and from slightly acid to mildly alkaline in the lower part. Some profiles lack a IIB3t horizon. The B1 and B2 horizons have a hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. Their mottles have a hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 8. The texture is loam, sandy clay loam, or clay loam. The IIB horizon is finer textured than the overlying horizons. Its texture is clay or silty clay. This horizon is 10YR in hue, 4 or 5 in value, and 2 or 3 in chroma. Mottles in the IIB horizon have a hue of 10YR, value of 4 or 5, and chroma of 4 to 6.

Haskins soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Rawson soils and the very poorly drained Mermill soils. Haskins soils differ from Digby soils in that Haskins soils are underlain by fine-textured material; whereas Digby soils are underlain by gravel and sand. Haskins soils are finer textured in the uppermost horizons than Rimer soils. Haskins soils, like Rimer soils, are fine textured in the lower part of the B horizon and in the C horizon.

Haskins fine sandy loam, 0 to 2 percent slopes (HkA).—This soil is in slightly elevated oval areas that commonly are near Hoytville and Nappanee soils. Less extensively, this soil is near the sandy Rimer and Seward soils. Individual areas generally are only a few acres in size. This soil has a profile similar to the one described as representative for the series, but its surface layer has a higher content of fine sand. The sandier texture makes this soil more friable and easier to cultivate than Haskins loam, 0 to 2 percent slopes.

Included with this soil in mapping were spots of Nappanee loam, spots of soils that have a sandy loam surface layer, and spots of soils that have slopes of 2 to 6 percent.

Seasonal wetness is a moderate limitation if this soil is farmed. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–2.

Haskins fine sandy loam, 2 to 6 percent slopes (HkB).—This soil is mainly on the low stream terraces and outwash plains near the Digby, Blount, and Nappanee soils. It is also near first-bottom soils, such as Genesee and Sloan. The areas are quite long and narrow on the terraces, and they are irregular in shape on the local outwash plains. This soil has a profile similar to the one described as representative for the series, but its surface layer has a higher content of fine sand. The sandier texture makes this soil more friable and easier to cultivate than Haskins loam, 0 to 2 percent slopes.

Included with this soil in mapping were spots of Haskins fine sandy loam, 0 to 2 percent slopes, and spots of Nappanee loam, Blount loam, and Del Rey loam. Also included were spots of Genesee and Sloan alluvial soils.

Seasonal wetness is a moderate limitation if this soil is farmed. Also, erosion is a hazard, particularly in the longer and steeper areas. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–2.

Haskins loam, 0 to 2 percent slopes (HnA).—This soil is mainly in elongated areas on beach ridges that are slightly higher than the surrounding lake plain. Less extensively, it is in small oval or irregularly shaped areas on moraines. This soil commonly is near the Mermill, Digby, Nappanee, Del Rey, and Hoytville soils. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of Digby loam and Nappanee loam, spots of soils that have a silt loam surface layer, and spots of soils that have slopes of 2 to 6 percent. Seasonal wetness is a moderate limitation if this soil is farmed. Seasonal wetness is also the main limitation to many nonfarm uses. Capability unit IIw–2.

Haskins loam, 2 to 6 percent slopes (HnB).—This soil commonly is on beach ridges and terraces. Less extensively, it is in isolated irregularly shaped areas at some of the higher elevations on the moraines. Common nearby soils are the alluvial Genesee, Sloan, Digby, Nappanee, and Hoytville soils. On the moraines, nearby soils include the Blount and Pewamo.

Included with this soil in mapping were spots of Haskins fine sandy loam, Digby loam, and Nappanee loam; spots of soils that have a silt loam surface layer; and spots of nearly level soils.

Seasonal wetness is a moderate limitation. Erosion is a hazard, particularly where slopes are longer and steeper. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–2.

Hoytville Series

The Hoytville series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in clay or silty clay glacial till that has been somewhat modified in the upper part by water action at the bottom of former lakes. They are on broad flats of the lake plain.

In a representative profile of a Hoytville soil that is cultivated, the plow layer is very dark grayish-brown clay about 8 inches thick. The subsoil is 36 inches thick. The upper 16 inches is dark-gray silty clay mottled with brown and dark yellowish brown. The lower 20 inches is gray silty clay mottled with dark yellowish brown and yellowish brown. The substratum extends from a depth of 44 inches to a depth of 70 inches or more. It consists of gray silty clay that is mottled with strong brown and dark yellowish brown in the upper part and yellowish brown in the lower part.

Runoff on Hoytville soils is very slow, and permeability is slow. Available water capacity is high. The root zone is deep if adequately drained. It is neutral to mildly alkaline.

Hoytville soils are farmed intensively, mainly to corn and soybeans. Most of the acreage has been artificially drained for improved plant growth and timely tillage.

Representative profile of Hoytville clay in a cultivated field in Monterey Township, SE¼NW¼ sec. 36, T. 1 S., R. 4 E., Laboratory No. PT–22:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) clay; moderate, fine and medium, subangular blocky structure; friable; few small fragments of black shale, chert, and igneous pebbles as much as one-half inch in diameter; common roots; slightly acid; abrupt, smooth boundary.

B21tg—8 to 17 inches, dark-gray (10YR 4/1) silty clay; common, medium, faint, brown (10YR 4/3) mottles; moderate, fine and medium, subangular blocky structure; firm; few small fragments of black shale, chert, and igneous material as much as one-half inch in diameter; thin, patchy, dark-gray (10YR 4/1) clay films on vertical and horizontal ped faces; common roots, neutral; gradual, smooth boundary.

B22tg—17 to 24 inches, dark-gray (10YR 4/1) silty clay; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak medium, prismatic structure in place, parting to weak, fine and medium, subangular blocky; firm; thin, continuous, dark-gray (10YR 4/1) clay films on vertical and horizontal ped faces; few fragments of black shale, chert, and igneous material as much as one-half inch in diameter; common roots; neutral; gradual, smooth boundary.

B23tg—24 to 35 inches, gray (10YR 5/1) silty clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure in place, parting to moderate, fine and medium, subangular blocky; firm; thin, continuous, dark-gray (10YR 4/1) clay films on vertical faces; few fragments of black shale, chert, and igneous material as much as one-half inch in diameter; common roots; neutral; gradual, wavy boundary.

B24tg—35 to 44 inches, gray (10YR 5/1) silty clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, prismatic structure in place, parting to weak, fine and medium, subangular blocky; firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical faces; few fragments of black shale, chert, and igneous material as much as one-half inch in diameter; few roots; mildly alkaline; abrupt, wavy boundary.

C1—44 to 60 inches, gray (10YR 5/1) silty clay; many, medium, prominent, strong-brown (7.5YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; weak, medium and coarse, subangular blocky structure; very firm; few fragments of black shale, chert, and igneous material as much as 1 inch in diameter; few roots; mildly alkaline, calcareous; clear, wavy boundary.

C2—60 to 70 inches, gray (10YR 5/1) silty clay; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; massive; very firm; mildly alkaline, calcareous glacial till.

The solum ranges from 36 to 52 inches in thickness, but it is generally 40 to 45 inches thick. The A horizon is dominantly clay, but it is silty clay or silty clay loam in places. Although the dominant texture is clay, the clay is very near the separating point between silty clay and clay. In northwestern Ohio, most of the Hoytville soils have a clay texture rather than a silty clay texture in the A horizon. The Ap horion has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is slightly acid to neutral. The B horizon matrix color has a hue of 10YR or 2.5Y, value of 4, 5, or 6, and chroma of 1. Mottles are 10YR or 7.5YR in hue, 4 or 5 in value, and 3 to 6 in chroma. The texture is silty clay or clay, and reaction ranges from slightly acid to mildly alkaline. The C horizon has a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 or 2. Its mottles have a hue of 10YR, 2.5Y, or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The texture of the calcareous glacial till is silty clay, clay, or heavy clay loam.

Hoytville soils are the very poorly drained members of a drainage sequence that includes the moderately well drained St. Clair soils and the somewhat poorly drained Nappanee soils. Hoytville soils are finer textured than the Pewamo soils that formed in clay loam or silty clay loam glacial till. Hoytville soils have more sand and pebbles in the A and B horizons than do the Latty or Toledo soils. They have less clay in the B horizon then the Paulding soils, and they generally have somewhat less clay in the B horizon than Latty soils. Hoytville soils differ from Lenawee soils in having a higher content of clay and a lower content of sand in the B horion. They formed in glacial till, whereas Lenawee soils formed in stratified lacustrine material.

Hoytville silty clay loam (Ho).—This nearly level soil is on flats of the lake plain, commonly east of Jennings Creek and the Auglaize River in the southern part of the county. Generally, it is near areas of Nappanee soils and soils of the beach ridges and stream terraces. This soil has a profile similar to the one described as representative for the series, but its surface layer has a lower content of clay. Consequently, it has a wider range of optimum moisture for tillage than Hoytville clay.

Included with this soil in mapping were spots of lighter colored, somewhat poorly drained Nappanee soils. Also included were areas of soils that have a clay loam surface layer. Small areas of the coarser textured Millgrove and Mermill soils were included in some places.

Wetness is the major limitation to use of this soil for farming. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw–6.

Hoytville clay (Hv).—This nearly level soil is on broad flats of the lake plains in the northeastern and southwestern sections of the county. It generally is near small, slightly elevated areas of Nappanee soils. A profile of this soil is described as representative for the series.

Included with this soil in mapping were small spots of lighter colored, somewhat poorly drained Nappanee soils. In places this Hoytville soil has a thinner subsoil than is typical for its series.

Wetness is the major limitation to farm use of this soil. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw–6.

Kibbie Series

The Kibbie series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in stratified loamy material on the lake plain.

In a representative profile of a Kibbie soil that is cultivated, the plow layer is dark grayish-brown loam 9 inches thick. The subsoil is 27 inches thick. The uppermost part is 7 inches of grayish-brown loam mottled with yellowish brown; the middle layer is 14 inches of yellowish-brown loam mottled with dark grayish brown; and the lowermost part is 6 inches of grayish-brown heavy loam mottled with yellowish brown. The substratum, which begins at a depth of 36 inches and extends to a depth of 60 inches or more, is yellowish-brown fine sandy loam mottled with grayish brown.

Runoff is slow on Kibbie soils, and permeability is moderate. These soils have a seasonal high water table. Available water capacity is high. If these soils are adequately drained, the root zone is deep. These soils are medium acid in the most acid layer, but they grade to mildly alkaline as depth increases.

Kibbie soils are used mainly for corn, soybeans, and small grain. Most of the acreage has been artificially drained for improved plant growth and timely tillage.

Representative profile of Kibbie loam, 0 to 2 percent slopes, in a cultivated field in Blanchard Township, NE½ NE¼ sec. 24, T. 1 N., R. 8 E.:

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

B1—9 to 16 inches, grayish-brown (10YR 5/2) loam, many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine and medium, subangular blocky structure; very friable; medium acid; diffuse, wavy boundary.

B21t—16 to 30 inches, yellowish-brown (10YR 5/4) heavy loam; many, fine, distinct, dark grayish-brown (10YR 4/2) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal faces of peds; slightly acid; diffuse, wavy boundary.

B22t—30 to 36 inches, grayish-brown (10YR 5/2) heavy loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal faces of peds; neutral; clear, wavy boundary.

C—36 to 60 inches, yellowish-brown (10YR 5/6) fine sandy loam; many, medium and coarse, distinct, grayish-brown (10YR 5/2) mottles; massive; friable; mildly alkaline, calcareous.

The solum ranges from 30 to 45 inches in thickness, but it generally is 32 to 38 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or grayish-brown (10YR 5/2).

It is loam or silt loam. The upper part of the B horizon is medium acid to slightly acid, and the lower part is slightly acid to neutral. The B1 horizon has a hue of 10YR, value of 4, 5, or 6, and chroma of 2. Its mottles have a hue of 10YR, value of 4 or 5, and chroma of 4 to 8. The upper part of the Bt horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. Mottles have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The lower part of the Bt horizon has a hue of 10YR, value of 4 or 5, and chroma of 4 to 8. The B horizon is loam, heavy loam, or clay loam. The C horizon is stratified fine sandy loam, sandy loam, and silt loam.

The Kibbie soils in this county have colors of low chroma on ped faces in the lower part of the Bt horizon, and they have a lighter colored A horizon than is within the range defined for the series. These differences do not greatly influence the use or behavior of these soils.

Kibbie soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Tuscola soils and the very poorly drained Colwood soils. Kibbie soils generally have a higher sand content than Digby soils, and they lack fine pebbles. They are coarser textured than Del Rey soils.

Kibbie loam, 0 to 2 percent slopes (KbA).—This soil is mostly on beach ridges near Haskins, Colwood, Digby and other soils that are common on the beach ridges. It also is in the Findlay Basin near Del Rey and Lenawee soils and on the Defiance moraine near the Tuscola, Shinrock, Del Rey, and Toledo soils. Areas in most places are small in size and irregular or oval in shape. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of Del Rey, Digby, Haskins, and Tuscola soils. Also included were spots of soils that have a fine sandy loam surface layer and spots of soils that have 2 to 6 percent slopes.

This soil is friable and easy to keep in good tilth. Seasonal wetness is a moderate limitation in farmed areas. Seasonal wetness limits many nonfarm uses. Capability unit IIw-2.

Kibbie silt loam, 0 to 2 percent slopes (KsA).—This soil commonly is on elevated flats of stream terraces. Areas are small and oval in most places. On the Defiance moraine, this soil is near Del Rey and Fulton soils. It also is in the Findlay basin near the Del Rey and Lenawee soils. This soil has a profile similar to the one described as representative for the series, but the surface layer has a lower content of sand. This soil is slightly less easy to cultivate than Kibbie loam, 0 to 2 percent slopes, and is more subject to surface crusting.

Included with this soil in mapping were spots of Del Rey silt loam and spots of soils that have 2 to 6 percent slopes.

Seasonal wetness is a moderate limitation of this soil for farming. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw-2.

Kibbie-Del Rey silt loams, 1 to 6 percent slopes (KtB).—This complex is on the Defiance moraine. Del Rey soils make up 40 percent of this unit, Kibbie soils 40 percent, and the Haskins, Fulton, Tuscola, and Shinrock soils make up the remaining 20 percent. The Kibbie soils have a profile similar to the one described as representative for the Kibbie series, except that they have a lower content of sand. The Del Rey soils have the profile described as representative for the Del Rey series. Most areas are long and narrow, and the long axis is generally oriented north and south. Nearby soils include the Toledo, Del Rey, Fulton, and Kibbie soils.

Seasonal wetness is a moderate limitation to use of these soils for farming. Also, erosion is a hazard, particularly in the longer and steeper areas. Wetness limits many nonfarm uses. Capability unit IIw-2.

Latty Series

The Latty series consists of nearly level soils that are very poorly drained. These soils formed in clay or heavy clay loam lacustrine and till material. They are on some of the broad, nearly level flats of the lake plain.

In a representative profile of a Latty soil that is cultivated, the plow layer is dark-gray clay about 7 inches thick. The subsoil is 41 inches thick. The uppermost part is 6 inches of dark-gray clay mottled with dark yellowish brown; next is 10 inches of dark-gray clay mottled with yellowish brown; the next is 18 inches of dark-gray clay mottled with yellowish brown and dark yellowish brown; and the lowermost part is 7 inches of gray clay mottled with yellowish brown. The substratum, which begins at a depth of 48 inches and extends to a depth of 60 inches or more, is gray clay mottled with yellowish brown.

Runoff is very slow on Latty soils, and permeability is very slow. Available water capacity is medium. These soils are saturated with water for long periods in winter and in spring, and they are slow to dry out in spring unless adequately drained. The root zone is moderately deep. These soils are slightly acid to neutral in the upper part of the root zone.

Latty soils are used mainly for cultivated crops. Most of the cultivated acreage has been artificially drained for improved plant growth and timely tillage.

Representative profile of Latty clay in a cultivated field in Union Township, SE¼NW¼ sec. 9, T. 1 S., R. 6 E.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) clay; moderate, very fine, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

B21g—7 to 13 inches, dark-gray (10YR 4/1) clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure; very firm; neutral; diffuse, wavy boundary.

B22g—13 to 23 inches, dark-gray (10YR 4/1) clay; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; strong, fine and medium, subangular blocky structure; very firm; neutral; diffuse, wavy boundary.

B23g—23 to 41 inches, dark-gray (10YR 4/1) clay; many, medium, distinct, yellowish-brown (10YR 5/4) and dark yellowish-brown (10YR 4/4) mottles; strong, fine, subangular blocky structure; very firm; neutral; diffuse, wavy boundary.

B3g—41 to 48 inches, gray (10YR 5/1) clay; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; very firm; mildly alkaline, calcareous; clear, wavy boundary.

Cg—48 to 60 inches, gray (10YR 5/1) clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; extremely firm; mildly alkaline, calcareous.

The solum ranges from 35 to 50 inches in thickness. This generally coincides with the depth to carbonates. The upper part of the solum is slightly acid to neutral, and the lower part is neutral to mildly alkaline. The Ap horizon has a hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. It is clay or silty clay. The Bg horizon matrix colors have a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. The mottles have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. This horizon is clay or silty clay. In the C horizon the colors are similar to those of the Bg horizon. Texture is clay or heavy clay loam.

Latty soils are the very poorly drained members in a drainage sequence that includes the somewhat poorly drained Nappanee soils and the moderately well drained St. Clair soils. Latty soils are transitionary between Hoytville and Paulding soils with respect to color of the surface layer and the clay content of the solum. Latty soils generally have a darker Ap horizon than Paulding soils and a lighter Ap horizon than Hoytville soils. Latty soils have less clay in the Bg horizon than Paulding soils, and they commonly have somewhat more clay in the Bg horizon than Hoytville soils. Latty soils have less clay in the C horizon than Paulding soils, and they have the same or a greater clay content in this horizon than Hoytville soils. Latty soils have a somewhat lighter colored A horizon and a less well developed structure than the very poorly drained Toledo soils.

Latty silty clay loam (Lo).—This nearly level soil generally is near low-lying sandy ridges or near the Nappanee loams. It has a profile similar to the one described as representative for the series, but its surface layer contains more silt and less clay; consequently, good tilth is easier to maintain in this soil than in Latty clay.

Included with this soil in mapping were spots of soils that have a surface layer of clay and spots of somewhat poorly drained Nappanee soils, generally on slight rises surrounded by this soil.

Very poor natural drainage is a severe limitation to farm use. Excessive wetness and very slow permeability are major limitations to most nonfarm uses. Capability unit IIIw-2.

Latty clay (Lc).—This nearly level soil is on broad flats of the lake plain, commonly adjacent to Hoytville and Paulding soils. The continuity of the areas is broken in a few places by a stream valley or a low offshore beach ridge. A profile of this soil is described as representative of the series. Maintenance of favorable tilth on this soil is difficult because of the clayey surface layer. Cultivating this soil when it is wet is especially damaging to its tilth.

Included with this soil in mapping were spots of lighter colored Paulding soils or darker colored Hoytville soils. Also included were spots of the somewhat poorly drained Nappanee soils, which generally are on slight rises within areas of this Latty soil.

Very poor natural drainage and the clay texture are major limitations to farm uses. This soil dries out slowly in spring, and artificial drainage is difficult. Excessive wetness, very slow permeability, and the clay texture are major limitations to most nonfarm uses. Capability unit IIIw-2.

Lenawee Series

The Lenawee series consists of nearly level, very poorly drained soils. These soils formed in stratified silty clay loam, silt loam, and sandy loam lacustrine material on the flats of the lake plain, mainly in northern Riley Township and in parts of southern Blanchard Township.

In a representative profile of a Lenawee soil that is cultivated, the plow layer is very dark-gray silty clay loam about 9 inches thick. The subsoil is 39 inches thick. The upper part is 7 inches of dark grayish-brown silty clay loam mottled with dark yellowish brown; the middle part is 14 inches of dark grayish-brown heavy clay loam mottled with yellowish brown. The lower part is 18 inches of gray heavy clay loam mottled with yellowish brown. The substratum begins at a depth of 48 inches and reaches a depth of 60 inches or more. It is yellowish-brown, stratified silty clay loam, silt loam, and sandy loam mottled with gray.

Lenawee soils have very slow runoff and moderately slow permeability. Available water capacity is high. The root zone is deep if these soils are adequately drained. It is mostly neutral.

Lenawee soils are used mostly for cultivated crops, such as corn, soybeans, and small grain. Most of the acreage has been artificially drained for improved plant growth and timely tillage.

Representative profile of Lenawee silty clay loam in a cultivated area in Blanchard Township, SW¼SW¼ sec. 33, T. 1 N., R. 8 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

B21g—9 to 16 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; neutral; diffuse, wavy boundary.

B22g—16 to 30 inches, dark grayish-brown (10YR 4/2) heavy clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; few, thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; neutral; clear, wavy boundary.

B23g—30 to 48 inches, gray (10YR 5/1) heavy clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; few, thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; mildly alkaline; clear, wavy boundary.

C—48 to 60 inches, yellowish-brown (10YR 5/6) stratified silty clay loam, silt loam, and sandy loam; many, medium, distinct, gray (10YR 5/1) mottles; massive; friable; mildly alkaline, calcareous.

The solum ranges from 44 to 60 inches in thickness, but it commonly is about 50 inches thick. This commonly coincides with the depth to carbonates. The solum is slightly acid to neutral in the upper part, and it is mildly alkaline in the lower part. The Ap horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam. The B horizon matrix colors have a hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 or 2. Its mottles have a hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 4 to 8. The texture is heavy silty clay loam or heavy clay loam. In some profiles, thin silty clay or clay layers are present. The C horizon has a hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. Its mottles are of the same hue and value, but the chroma is 1 or 2. This horizon is stratified with layers that are dominantly silty clay loam, silt loam, and sandy loam.

Lenawee soils have a thicker solum than is within the range defined for the series, but this difference does not alter their usefulness or behavior.

Lenawee soils are the very poorly drained members of a drainage sequence that includes the somewhat poorly drained Del Rey soils and the moderately well drained Shinrock soils. Lenawee soils are not so fine textured in their B and C horizons as are the Toledo soils, which formed in lacustrine clay and silt. Lenawee soils have finer textured B and C horizons than do the Colwood soils, which formed in lacustrine silt and fine sand that contains some clay.

Lenawee silt loam (Ln).—This nearly level soil commonly is near beach ridges and stream terraces. It also is in small, elongated areas on the moraines near the Toledo, Del Rey, and some of the sandier soils. In a few places it is in local outwash areas on the lake plain. This soil has a profile similar to the one described as representative for the series, but its surface layer is siltier. Consequently, favorable tilth is easier to maintain in this soil than in Lenawee silty clay loam, and crops grow somewhat better.

Included with this soil in mapping were spots of soils that have a surface layer of silty clay loam and spots of the finer textured Toledo soils. Also included were spots of the coarser textured Colwood soils.

Wetness is a moderate limitation to farm use. Wetness and moderately slow permeability are limitations to most nonfarm uses. Capability unit IIw–5.

Lenawee silty clay loam (Ls).—This nearly level soil commonly is on broad flats of the Findlay Basin near the Del Rey soils. Less commonly, it is near beach ridges and stream terraces. The areas generally are large and have no definite pattern or shape, but the soil conditions are uniform. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of the somewhat poorly drained, lighter colored Del Rey soils that commonly are near drainageways. Also included in some areas were spots of the finer textured Toledo soils and in other areas spots of the coarser textured Colwood soils.

Wetness is a moderate limitation to farm use, and it is a limitation to most nonfarm uses. Capability unit IIw–5.

Lucas Series

The Lucas series consists of gently sloping to moderately steep soils that are moderately well drained. These soils formed in clayey lacustrine sediment on valley sides adjacent to streams that flow through the lake plain.

In a representative profile of a Lucas silty clay loam that is cultivated, the plow layer is grayish-brown silty clay loam 7 inches thick. The upper 5 inches of the subsoil is brown silty clay, and the lower 8 inches is brown clay mottled with light yellowish brown. The substratum, which begins at a depth of 20 inches and extends to a depth of 60 inches or more, is dark-brown silty clay mottled with gray.

Runoff is rapid on Lucas soils. Permeability is slow, and these soils are saturated for short periods, mostly in spring, which limits timely tillage. The clayey subsoil and substratum restrict root penetration. Available water capacity is medium. The root zone is moderately deep. Reaction in the root zone generally is strongly acid in the most acid layer. Below the root zone reaction grades to slightly acid to mildly alkaline with increasing depth.

Corn, soybeans, small grain, and hay are grown on the gently sloping and sloping Lucas soils. Steeper areas of these soils are used for pasture and woodland.

Representative profile of a Lucas silty clay loam, 2 to 6 percent slopes, in a cultivated field in Greensburg Township, NW¼NE¼ sec. 14, T. 1 N., R. 6 E.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silty clay loam; moderate, fine and medium, granular structure; friable; medium acid; abrupt, smooth boundary.

B&A—7 to 12 inches, brown (10YR 5/3) silty clay; moderate, fine and medium, subangular blocky structure; firm; few, thin, patchy, grayish-brown (10YR 5/2) clay films on ped faces and pore linings; strongly acid; clear, wavy boundary.

B2t—12 to 20 inches, brown (10YR 4/3) clay; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; moderate, medium, subangular blocky structure; very firm; few, thin, patchy, brown (10YR 5/3) clay films on vertical and horizontal ped faces and along old root channels; slightly acid; abrupt, wavy boundary.

C—20 to 60 inches, dark-brown (10YR 4/3) silty clay; many, medium, distinct, gray (10YR 5/1) mottles; massive; very firm; thin layers of silt and fine sand in places; mildly alkaline, calcareous.

The solum ranges from 20 to 25 inches in thickness. Depth to carbonates ranges from 18 to 25 inches. The Ap horizon is grayish brown (10YR 5/2) or brown (10YR 5/3). The upper part of the B horizon ranges from strongly acid to slightly acid, and the lower part is slightly acid. Reaction of the C horizon increases with depth to neutral or mildly alkaline. The B horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay or clay. The C horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Mottles in the C horizon have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. This horizon is silty clay or clay.

Lucas soils are moderately well drained members of a drainage sequence that includes the somewhat poorly drained Fulton soils, the very poorly drained Toledo soils, and the very poorly drained and very dark colored Bono soils. Lucas soils are finer textured than the moderately well drained Shinrock soils and coarser textured than the moderately well drained Broughton soils.

Lucas silty clay loam, 2 to 6 percent slopes (LwB).—This soil generally lies along valley sides that are adjacent to streams that flow through the lake plain. The areas generally are long and narrow. This soil commonly is near Toledo and Fulton soils and alluvial soils. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of Shinrock soils and spots of somewhat poorly drained soils. Also included were areas of soils that have a loam or silt loam surface layer. Spots of moderately eroded soils were also included.

Erosion is a severe hazard if this soil is farmed. Slow permeability and a clayey texture are limitations to many nonfarm uses. Capability unit IIIe–2.

Lucas silty clay loam, 6 to 12 percent slopes, moderately eroded (LwC2).—This soil is on valley sides adjacent to streams that flow through the lake plain. This soil is in long, narrow areas on the stream breaks between the upland flats and the flood plains. The areas generally are too narrow to be managed separately. The present plow layer is a mixture of the material originally in the surface layer and part of the material originally in the subsoil. This soil needs more careful management for growing plants than the less eroded Lucas soils because it has a lower capacity to absorb and supply water to plants. Nearby soils commonly are Fulton and Toledo soils and the alluvial Defiance soils.

Included with this soil in mapping were spots of severely eroded soils and spots of steeper soils.

Further erosion is a very severe hazard if this soil is used for farming. Slope is a limitation to many nonfarm uses. Capability unit VIe–1.

Lucas silty clay loam, 12 to 18 percent slopes, moderately eroded (LwD2).—This soil is on valley sides that are adjacent to streams. Most areas of this soil are long and narrow. The present surface layer is a mixture of the material originally in the surface layer and part of the material in the subsoil. Total thickness of the surface layer and the subsoil is less than that of the uneroded

Lucas soils. Nearby soils commonly are the Fulton soils and the alluvial Defiance soils.

Included with this soil in mapping were spots of slightly eroded or severely eroded soils and spots of steeper soils.

Further erosion is a very severe hazard if this soil is farmed. This soil is suited to pasture and trees. Slope is a limitation to most nonfarm uses. Capability unit VIe–1.

Mermill Series

The Mermill series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed partly in loamy material and partly in the underlying, finer textured material. They commonly occur near beach ridges and on stream terraces and in areas of local outwash.

In a representative profile of a Mermill soil that is cultivated, the plow layer is very dark gray loam 9 inches thick. The subsoil is 31 inches thick. In the upper 11 inches it is dark grayish-brown clay loam mottled with yellowish brown; the next 14 inches is grayish-brown sandy clay loam mottled with yellowish brown; and the lower 6 inches is dark grayish-brown clay mottled with dark yellowish brown. The subsoil begins at a depth of 40 inches and extends to a depth of 60 inches or more. It is mottled, grayish-brown and yellowish-brown clay.

Runoff is very slow on Mermill soils. Permeability is moderate in the upper part of the profile and very slow in the lower part. Artificial drainage is essential. These soils have medium available water capacity. The root zone is moderately deep. It commonly is neutral, but as depth increases, reaction grades to mildly alkaline.

Mermill soils are used mostly for cultivated crops. Most of the acreage has been artificially drained for improved plant growth and more timely tillage. Corn, soybeans, small grain, and hay are the principal crops.

Representative profile of Mermill loam in a cultivated field in the Palmer Township, NW¼NW¼ sec. 12, T. 2 N., R. 6 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B21tg—9 to 20 inches, dark grayish-brown (10YR 4/2) clay loam; many, fine and medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy, dark-gray (10YR 4/1) clay films on horizontal and vertical ped faces; neutral; gradual, wavy boundary.

B22tg—20 to 34 inches, grayish-brown (10YR 5/2) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical and horizontal ped faces; neutral; abrupt, smooth boundary.

IIBg—34 to 40 inches, dark grayish-brown (10YR 4/2) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very firm; few fine pebbles; mildly alkaline; clear, wavy boundary.

IIC—40 to 60 inches, mottled, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) clay glacial till; massive; extremely firm; common fine pebbles; mildly alkaline, calcareous.

The solum ranges from 24 to 40 inches in thickness. Depth to the IIB horizon, which has the finer textured material, ranges from 20 to 40 inches, but most commonly it is about 35 inches. The Ap horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam or silty clay loam. The upper part of the B horizon ranges from slightly acid to mildly alkaline, and the lower part is neutral or mildly alkaline. The B2t horizon has a hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Its mottles have a hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 4 to 8. The IIB horizon has a hue of 10YR or 5Y, value of 4 or 5, and chroma of 1 or 2. Its mottles have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. Texture is clay, silty clay loam or heavy clay loam. The IIC horizon has a range in color and texture similar to those of the IIB horizon. The IIC horizon is calcareous, fine-textured glacial till or lacustrine material.

Mermill soils are the very poorly drained members of a drainage sequence that includes the somewhat poorly drained Haskins soils and the moderately well drained Rawson soils. Mermill soils are similar to Millgrove soils in some properties but lack their underlying sandy or gravelly sub-stratum. They lack the fine sand and silt content common to the very poorly drained Colwood soils. They are finer textured than the very poorly drained Wauseon soils.

Mermill loam (Md).—This nearly level soil commonly is near the more sandy soils in areas of local outwash and sandy lake deposits. The areas of this soil generally are oval, or they surround other better drained sandy soils that are in slightly higher positions. This soil is near Hoytville, Toledo, and Paulding soils. A profile of this soil is described as representative for the series.

Included with this soil in some mapped areas were spots of lighter colored, somewhat poorly drained Haskins soils. Also included in some areas were spots of finer textured Hoytville, Toledo, or Paulding soils. In addition, a few areas of soils that have a silt loam surface layer were included.

Wetness is a moderate limitation if this soil is farmed. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–5.

Mermill silty clay loam (Me).—This nearly level soil commonly is near low-lying ridges or offshore bars on the lake plain and is also near stream terraces. Less commonly it is in areas of local outwash. The areas of this soil are small, and they range from oval to long and narrow. This soil has a profile similar to the one described as representative for the series, but its surface layer contains more clay and less sand. This soil is more difficult to cultivate and to keep in good tilth than Mermill loam because its surface layer is more clayey.

Included with this soil in mapping were spots of lighter colored, somewhat poorly drained Haskins soils and small areas of more clayey, very poorly drained Hoytville, Toledo, and Paulding soils. Also included were a few areas of soils that have a surface layer of clay loam.

Wetness is a moderate limitation to farming. Seasonal wetness is a limitation to many nonfarm uses. Capability unit IIw–5.

Millgrove Series

The Millgrove series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in loamy material underlain by stratified sandy and gravelly material. They occur in areas near the base of beach ridges and in areas of local outwash.

In a representative profile of a Millgrove soil that is cultivated, the plow layer is very dark gray loam about 8 inches thick. Below the plow layer is 6 inches of very dark gray loam. The subsoil is 28 inches thick. The uppermost part is 12 inches of dark-gray, firm clay loam mottled with dark brown, and the lower part is 16 inches of dark-gray sandy clay loam. The substratum, which begins at a depth of 42 inches and extends to a depth of 60 inches or more, is yellowish-brown gravelly sandy loam mottled with dark gray.

Runoff is very slow on Millgrove soils, and permeability is moderate. These soils are saturated with water for a significant period in winter and spring. Available water capacity is high. The root zone is deep and slightly acid to neutral.

Millgrove soils are cultivated and are used mainly for corn, soybeans, and small grain. Most of the acreage has been artificially drained for improved plant growth and timely tillage.

Representative profile of Millgrove loam, in a cultivated field in Sugar Creek Township, SW¼SW¼ sec. 1, T. 2 S., R. 6 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loam; moderate, fine and medium, granular structure; very friable; neutral; abrupt, smooth boundary.

A12—8 to 14 inches, very dark gray (10YR 3/1) loam; weak, fine and medium, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.

B21tg—14 to 26 inches, dark-gray (10YR 4/1) clay loam; many, distinct, medium, dark-brown (10YR 4/3) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy, very dark gray (10YR 3/1) films on vertical and horizontal ped faces; few fine pebbles; neutral; clear, wavy boundary.

B22tg—26 to 42 inches, dark-gray (10YR 4/1) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; very firm; thin, patchy, very dark gray (10YR 3/1) clay films on horizontal ped faces and thin, continuous, very dark gray (10YR 3/1) clay films on vertical ped faces; few fine pebbles; neutral; abrupt, irregular boundary.

C—42 to 60 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; common, fine and medium, distinct, dark-gray (10YR 4/1) mottles; single grain; loose, moderately alkaline, calcareous; stratified fine gravel and sand.

The solum ranges from 35 to 44 inches in thickness, which commonly coincides with the depth to carbonates. The gravel content ranges from less than 5 percent to 20 percent in the solum and as much as 50 percent in the C horizon. Reaction in the lower part of the A horizon and the upper part of the B horizon ranges from slightly acid to neutral. The lower part of the B horizon is neutral or mildly alkaline. The A horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam or silty clay loam. Thickness of the A horizon ranges from 10 to 16 inches. The B2 horizon has a hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The mottles in this horizon have a hue of 7.5YR, 10YR, 5Y, or 2.5Y, a value of 4 to 6, and chroma of 3 or 4. Texture is clay loam, sandy clay loam, loam, or gravelly sandy clay loam. The C horizon has a hue of 10YR or 7.5YR, a value of 4 to 6, and chroma of 3 or 4.

Millgrove soils are the very poorly drained members of a drainage sequence that includes the well drained Belmore soils, the moderately well drained Haney soils, and the somewhat poorly drained Digby soils. The reddish-colored and moderately well drained Vaughnsville soils are nearby in places. Millgrove soils resemble Mermill soils, except that they have a sandy or gravelly substratum, rather than fine-textured material. Millgrove soils differ from the Colwood soils, which formed in lacustrine silt and fine sand, but Colwood soils lack the fine gravel that is present in Millgrove soils.

Millgrove loam (Mf).—This nearly level soil commonly is along the base of beach ridges in long, narrow areas. It also is on the flats of outwash areas. Along the beach ridges this soil generally is near Mermill, Digby, and Hoytville soil. In outwash areas it is near Digby, Haskins, and Mermill soils. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of lighter colored, somewhat poorly drained Digby soils. Also included were a few areas of soils that have a surface layer of silt loam or fine sandy loam.

Wetness is the major limitation to farming and to most nonfarm uses as well. This soil drains readily if artificial drainage is installed. Capability unit IIw-5.

Millgrove silty clay loam (Mg).—This nearly level soil generally is near beach ridges and stream terraces. Commonly it is between beach ridges, but it also is near the base of slopes of the stream terraces that are adjacent to first bottoms. The areas generally are long and narrow, or they are irregular in shape. This soil is commonly overwashed by runoff from adjacent higher areas. It has more clay in the surface layer than Mermill loam; therefore, favorable tilth is more difficult to maintain.

Included with this soil in mapping were spots of lighter colored, somewhat poorly drained Digby soils. Also included in places were small areas of finer textured Hoytville soils and a few areas of soils that have a surface layer of clay loam.

Wetness is the major limitation to use of this soil for farming and to most nonfarm uses. This soil drains readily if artificial drainage is installed. Capability unit IIw-5.

Morley Series

The Morley series consists of gently sloping soils that are moderately well drained. These soils formed in calcareous clay loam or silty clay loam glacial till. They are mainly on the glacial till plain in the southeastern part of the county, south of State Route No. 12. Small areas also occur in the east-central part of the county, but these areas are widely scattered.

In a representative profile of a Morley soil that is cultivated, the plow layer is dark grayish-brown silt loam 6 inches thick. The subsoil is 26 inches thick. The uppermost layer is 6 inches of brown clay loam, the next layer is 8 inches of dark yellowish-brown clay, the next is 5 inches of yellowish-brown clay mottled with grayish-brown, and the lowermost layer is 7 inches of brown clay loam mottled with gray. The substratum begins at a depth of 32 inches and extends to a depth of 60 inches. It is dark yellowish-brown clay mottled with gray.

Runoff is moderate to rapid on Morley soils, and permeability is slow. These soils are saturated for short periods, mostly in spring, which limits timely tillage. Available water capacity is medium. The clayey subsoil and the underlying till restrict root penetration. Nevertheless, most annual crops develop roots to a moderate depth. The root zone generally is medium acid in the most acid layer. With increasing depth below the root zone, these soils grade to mildly alkaline.

Morley soils are used primarily for corn, soybeans, small grain, and hay.

Representative profile of Morley silt loam, 2 to 6 percent slopes, in a cultivated field in Riley Township, SW¼SE¼ sec. 26, T. 1 S., R. 8 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B1t—6 to 12 inches, brown (10YR 5/3) clay loam; moderate, medium, subangular blocky structure; friable; thin, patchy, brown (10YR 5/3) clay films on vertical ped faces; 4 percent fine pebbles; medium acid; clear, wavy boundary.

B21t—12 to 20 inches, dark yellowish-brown (10YR 4/4) clay; moderate, medium, subangular blocky structure; firm; thin, patchy, brown (10YR 4/3) clay films on vertical and horizontal faces; 4 percent fine pebbles; medium acid; diffuse, wavy boundary.

B22t—20 to 25 inches, yellowish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; very firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical and horizontal ped faces; 4 percent fine pebbles; neutral; diffuse, wavy boundary.

B3t—25 to 32 inches, brown (10YR 4/3) clay loam; many medium, distinct, gray (10YR 5/1) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; thin patchy, contrasting, gray (10YR 5/1) clay films on vertical faces and continuously along old root channels; 4 percent fine pebbles; mildly alkaline, calcareous; diffuse, wavy, boundary.

C—32 to 60 inches, dark yellowish-brown (10YR 4/4) clay loam; many, medium, distinct, gray (10YR 5/1) mottles; massive; very firm; 4 percent fine pebbles; mildly alkaline, calcareous glacial till.

The solum ranges from 20 to 34 inches in thickness, which commonly coincides with the depth to carbonates. The Ap horizon is dark grayish-brown (10YR 4/2) or brown (10YR 4/3). The upper part of the B horizon ranges from medium acid to strongly acid, and the lower part is neutral or mildly alkaline. The B1t horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Its texture is clay loam or silty clay loam. The B21t horizon has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Its texture is clay or silty clay. The B22t horizon has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. Mottles in the lower part of this horizon have a hue of 10YR, value of 4 to 6, and chroma of 2. Its texture is clay or silty clay. The B3t horizon, where present, has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. Its mottles have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Texture is clay loam or silty clay loam. The C horizon has a hue of 10YR, value of 4 to 6, and chroma of 3 to 6. Its mottles have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The texture is clay loam or silty clay loam.

Morley soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Blount soils and the very poorly drained Pewamo soils. Morley soils have less clay in the B and C horizons than St. Clair soils. They have more clay in the B and C horizons than Shinrock soils.

Morley silt loam, 2 to 6 percent slopes (MrB).—This soil commonly is on slope breaks, adjacent to streams that flow through the moraines.

Included in mapping in most areas were spots of somewhat poorly drained Blount soils, spots of soils that have a loam surface layer, and spots of moderately eroded soils.

Erosion is a severe hazard if this soil is used for farming. Slow permeability is a limitation to many nonfarm uses. Capability unit IIIe-2.

Nappanee Series

The Nappanee series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in heavy clay loam, silty clay, or clay glacial till that has been somewhat modified in the upper part by water action at the bottom of former lakes. They are on slight rises on the lake plain.

In a representative profile of a Nappanee soil that is cultivated, the surface layer is 8 inches of dark grayish-brown silt loam that is underlain by 3 inches of dark grayish-brown clay loam. The subsoil is 23 inches thick. Between depths of 11 and 29 inches the subsoil is grayish-brown clay mottled with dark yellowish brown, and between depths of 29 and 34 inches, it is grayish-brown silty clay mottled with dark yellowish brown and yellowish brown. The substratum, which begins at a depth of 34 inches and extends to a depth of 60 inches or more, is grayish-brown, silty clay glacial till mottled with dark brown and dark yellowish brown.

Nappanee soils have slow runoff and very slow permeability. They are saturated with water in winter and in spring and are slow to dry out and warm up in spring unless adequately drained. These soils have medium available water capacity. They have a moderately deep root zone. It is very strongly acid to medium acid in the uppermost 18 inches.

Nappanee soils are principally used for corn, soybeans, and small grain.

Representative profile of Nappanee silt loam, 0 to 2 percent slopes, in Monterey Township, SW¼NW¼ sec. 36, T. 1 S., R. 4 E., Laboratory No. Pt.-21:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, weak, fine and medium, granular structure; very friable; strongly acid; abrupt, smooth boundary.

A2g—8 to 11 inches, dark grayish-brown (10YR 4/2) clay loam; many, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak, medium, platy structure in place parting to weak, very fine, subangular blocky; friable; 5 percent fine pebbles; very strongly acid; abrupt, smooth boundary.

B21tg—11 to 19 inches, grayish-brown (10YR 5/2) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical and horizontal ped faces and in root channels; 5 percent fine and medium pebbles; very strongly acid; gradual, smooth boundary.

B22tg—19 to 29 inches, grayish-brown (10YR 5/2) clay; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky structure; very firm; thin, patchy, gray (10YR 5/1) clay films on vertical and horizontal ped faces and along root channels; 5 percent fine and medium pebbles; slightly acid; abrupt, wavy boundary.

B3t—29 to 34 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak and moderate, fine and medium, subangular blocky structure; very firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces and along root channels; few fragments of black shale, chert, and igneous material as much as 1 inch in diameter and making up 5 to 10 percent by volume; mildly alkaline, calcareous; clear, smooth boundary.

C—34 to 60 inches, grayish-brown (10YR 5/2) silty clay; many, medium, distinct, dark-brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) mottles; massive; extremely firm; compact glacial till; mildly alkaline, calcareous.

The solum ranges from 20 to 36 inches in thickness, which commonly coincides with the depth to carbonates. In places the solum extends into the calcareous material for several inches. The Ap horizon is dark grayish-brown (10YR 4/2) or grayish-brown (10YR 5/2) silt loam, loam, or silty clay loam. The B horizon is very strongly acid to medium acid in the upper part and neutral to mildly alkaline in the lower part. The B2 horizon has a hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. The mottles have a hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 to 8. Texture of the B2 horizon is clay or silty clay. The B3 and C horizons have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Their mottles have a hue of 10YR, value of 3 to 5, and chroma of 3 to 6. The texture of these horizons is silty clay, clay, or heavy clay loam.

Nappanee soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained St. Clair soils and the very poorly drained Hoytville soils. Nappanee soils also occur adjacent to the darker colored Latty soils. They have finer textured B and C horizons than the similar, somewhat poorly drained Blount soils. They have less clay in their B and C horizons than the somewhat poorly drained Roselms soils, which formed in fine-textured lacustrine material. Nappanee soils have a texture similar to that of Fulton soils; however, Fulton soils formed in lacustrine material.

Nappanee loam, 0 to 2 percent slopes (NaA).—This soil generally is on slight rises of the lake plain, and it seems to be the remnants of former beach ridges or low offshore bars. It has a profile similar to the one described as representative for the series, but it has more sand in the surface layer. It is thus more easily tilled and is less subject to crusting than Nappanee silt loam, 0 to 2 percent slopes. Small, oval areas or somewhat elongated areas of this soil are near areas of other Nappanee soils and of Haskins soils.

Included with this soil in mapping were spots of slightly steeper soils and spots of coarser textured Haskins soils.

Seasonal wetness is a severe limitation where this soil is farmed. Seasonal wetness and very slow permeability are limitations to many nonfarm uses. Capability unit IIIw-1.

Nappanee loam, 2 to 6 percent slopes (NaB).—This soil is mostly in oval areas or in long, narrow areas on low-lying beach ridges. It also is on stream terraces. Most commonly it is near the Digby and Haskins soils. This soil has a profile similar to the one described as representative for the series, but it has more sand in the surface layer. It is thus easier to till and less subject to crusting than Nappanee silt loam, 0 to 2 percent slopes.

Included with this soil in some mapped areas were spots of soils that have 0 to 2 percent slopes, spots of moderately well drained St. Clair soils, and spots of coarser textured Haskins soils.

Seasonal wetness is a severe limitation where this soil is farmed, and the hazard of erosion also is a limitation. Seasonal wetness and very slow permeability are the dominant limitations to many nonfarm uses. Capability unit IIIw-1.

Nappanee silt loam, 0 to 2 percent slopes (NpA).—This soil is mainly on slight rises of the lake plain. A profile of this soil is described as representative for the series. The areas are oval shaped and are surrounded by large areas of Hoytville and Latty soils in most places.

Included with this soil in mapping in places were spots of soils that have a finer textured surface layer and spots of slightly steeper soils.

Seasonal wetness is a severe limitation if this soil is used for farming. Seasonal wetness and very slow permeability are limitations to many nonfarm uses. Capability unit IIIw-1.

Nappanee silt loam, 2 to 6 percent slopes (NpB).—This soil is mostly adjacent to streams. Slopes generally are 2 to 4 percent. The areas of this soil are long and narrow and are near St. Clair, Hoytville, and Latty soils in most places.

Included with this soil in mapping in a few areas were spots of moderately well drained St. Clair soils and spots of moderately eroded soils.

Seasonal wetness is a severe limitation if this Nappanee soil is farmed; however, an erosion hazard is also a limitation to farm use. Seasonal wetness and very slow permeability are the dominant limitations to many nonfarm uses. Capability unit IIIw-1.

Nappanee silty clay loam, 0 to 2 percent slopes (NtA).—This soil is on slight rises of the lake plain, and most areas are near the Hoytville and Latty soils. The areas of this soil commonly are oval or slightly long and narrow and are surrounded by Hoytville or Latty soils in most places. This soil has a profile similar to the one described as representative for the series, but it has more clay in the surface layer; thus, it is not so easy to cultivate and is more subject to crusting than Nappanee silt loam, 0 to 2 percent slopes.

Included with this soil in mapping were a few areas of moderately eroded soils and a few areas of soils that have slopes of 2 to 6 percent. Also included were spots of Roselms soils, which have a finer textured subsoil.

Seasonal wetness is a severe limitation if this Nappanee soil is farmed. Seasonal wetness and very slow permeability are limitations to many nonfarm uses. Capability unit IIIw-1.

Ottokee Series

The Ottokee series consists of gently sloping soils that are moderately well drained. These soils formed in deep sands and are on sandy knolls of the moraine and on beach ridges of the lake plain.

In a representative profile of an Ottokee loamy fine sand that is cultivated, the plow layer is grayish-brown loamy fine sand 9 inches thick. The subsoil is 61 inches thick. To a depth of 38 inches, it is brown loamy fine sand mottled with yellowish brown; between depths of 38 and 46 inches, it is brown loamy fine sand mottled with yellowish brown; between depths of 46 and 64 inches, it is grayish-brown loamy fine sand that has yellowish-brown and dark yellowish-brown bands; and between depths of 64 and 70 inches, it is gray fine sand mottled with yellowish brown. The substratum, which begins at a depth of 17 inches and extends to a depth of 80 inches or more, is gray fine sand mottled with yellowish brown.

Runoff is slow on Ottokee soils, and permeability is rapid. Available water capacity is low. These soils are droughty, particularly in the latter part of the growing season. These sandy soils have good tilth and are easy to cultivate. The root zone is deep. It is slightly acid or medium acid in the most acid part. With increasing depth below the root zone, reaction increases to neutral or moderately alkaline.

Ottokee soils are used primarily for corn, soybeans, small grain, and hay.

Representative profile of Ottokee loamy fine sand, 1 to 6 percent slopes, in a cultivated field in Riley Township, SW¼SW¼ sec. 12, T. 1 S., R. 8 E.:

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

B21—9 to 26 inches, brown (10YR 5/3) loamy fine sand; few, fine, faint, yellowish-brown (10YR 5/4) mottles; single grain; loose; slightly acid; gradual, wavy boundary.

B22—26 to 38 inches, brown (10YR 5/3) loamy fine sand; many, fine, faint and distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; slightly acid; clear, wavy boundary.

B23—38 to 46 inches, grayish-brown (10YR 5/2) loamy fine sand; many, fine and medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; slightly acid; abrupt, wavy boundary.

B31&B24t—46 to 64 inches, grayish-brown (10YR 5/2) loamy fine sand; single grain; loose and has dark yellowish-brown (10YR 4/4) bands that have weak, fine, subangular blocky structure; bands range in thickness from less than one-eighth inch to slightly less than 1 inch, most are near the thin end of the range; friable; neutral; abrupt, irregular boundary.

B32—64 to 70 inches, gray (10YR 6/1) fine sand; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; neutral; diffuse, wavy boundary.

C—70 to 80 inches, gray (10YR 6/1) fine sand; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; moderately alkaline.

The solum ranges from 40 to 80 inches in thickness, but is most commonly 60 inches thick. Depth to carbonates generally coincides with this thickness. The upper part of the B horizon ranges from medium acid to slightly acid. The lower part of the B horizon is slightly acid to neutral. Reaction commonly increases gradually with depth. The B21 and B22 horizons have a hue of 10YR, value of 4 to 6, and chroma of 3 or 4. Mottles have a hue of 10YR, value of 4 to 6, and chroma of 4 to 8. These horizons are loamy fine sand or fine sand. The B23 horizon has a hue of 10YR, value of 4 to 6, and chroma of 2. The mottles in this horizon have a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. Texture is loamy fine sand or fine sand. The B31 horizon, which has the B24t bands, has a hue of 10YR, value of 4 to 6, and chroma of 2. The bands have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The combined thickness of the B24t bands is 3 to 4 inches. Texture of the B31 horizon material is loamy fine sand or fine sand, and texture of the B24t bands is loamy fine sand to a depth of 60 inches. The B32 horizon and the C horizon have a hue of 10YR, value of 5 or 6, and chroma of 1 to 2. The mottles have a hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The texture is fine sand and sand. In places the C horizon is neutral or mildly alkaline.

Ottokee soils are the moderately well drained members of the drainage sequence that includes the somewhat poorly drained Tedrow soils. In contrast to Seward soils, the Ottokee soils are not underlain by fine-textured material. Ottokee soils do not have the accumulative thickness of the B2t bands that exists in the Arkport soils. Ottokee soils are more sandy throughout their profile than the Tuscola soils.

Ottokee loamy fine sand, 1 to 6 percent slopes (OkB).—This soil is mainly in long narrow areas. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of the more poorly drained Tedrow soils, and spots of the better drained Arkport soils. Also included in some areas were spots of Seward soils that are underlain by fine-textured material, and other small areas of the finer textured Tuscola soils. In addition, a few areas of sloping soils were included.

Soil blowing is a severe hazard if this soil is used for farming. Damage to young plants occurs early in spring if the soil surface is not protected by a cover of vegetation. Droughtiness is a limitation to some nonfarm uses. Capability unit IIIs-1.

Ottokee-Tuscola complex, 2 to 6 percent slopes (OtB).—This complex consists of both Ottokee and Tuscola soils. Each of these soils makes up about 40 percent of the complex; the remaining 20 percent consists mostly of the more poorly drained Tedrow and Kibbie soils. The Ottokee soils and the Tuscola soils have a profile similar to the one described as representative for their respective series.

Included with these soils in mapping were a few areas of soils that have slopes of 6 to 12 percent.

In most areas soil blowing is a severe hazard if these soils are used for farming. Damage to young plants occurs early in spring if the surface of these soils is not protected by vegetative cover. Droughtiness is a limitation to some nonfarm uses in most areas. Capability unit IIIs-1.

Paulding Series

The Paulding series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in calcareous lacustrine clay on the broad flats of the lake plain.

In a representative profile of a Paulding soil that is cultivated, the plow layer is dark grayish-brown clay 6 inches thick. The subsoil is 39 inches thick. The uppermost 4 inches is gray clay mottled with brown; the next 4 inches is dark-gray clay mottled with dark yellowish brown; next is 16 inches of gray clay mottled with dark yellowish brown and yellowish brown; below this is 10 inches of gray clay mottled with olive brown; and the lowermost 5 inches is gray clay mottled with light olive brown. The substratum, which begins at a depth of 45 inches and extends to a depth of 60 inches or more, is gray, very firm lacustrine clay mottled with light olive brown.

Runoff is very slow to ponded on Paulding soils, and permeability is very slow. The available water capacity is medium. These soils are saturated with water for significant periods in winter and in spring, and they dry out slowly in spring. The root zone is moderately deep where these soils are adequately drained. The root zone is slightly acid to mildly alkaline.

Paulding soils are used mainly for soybeans, corn, small grain, and hay. Much of the cultivated acreage has been surface drained or drained by tile for increased plant growth and timely tillage. Water enters the tile drains slowly because of the high clay content and the weak structural development in the subsoil.

Representative profile of Paulding clay that is cultivated in Greensburg Township, SW¼SW¼ sec. 19, T. 1 N., R. 7 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) clay; weak, medium, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

B21g—6 to 10 inches, gray (10YR 5/1) clay; many, fine and medium, distinct, brown (10YR 4/3) mottles; weak, fine and medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

B22g—10 to 14 inches, dark-gray (10YR 4/1) clay; many, medium, distinct; dark yellowish-brown (10YR 4/4) mottles; moderate, medum, prismatic structure parting to weak, medium, subangular blocky; firm; neutral; diffuse, wavy boundary.

B23g—14 to 21 inches, gray (10YR 5/1) clay; many, medium and coarse, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; weak and moderate, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; neutral; diffuse, wavy boundary.

B24g—21 to 30 inches, gray (10YR 5/1) clay; many, fine and medium, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; moderate, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; neutral; diffuse, wavy boundary.

B25g—30 to 40 inches, gray (10YR 5/1) clay; common. medium, prominent, olive-brown (2.5Y 4/4) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; neutral; clear, wavy boundary.

B3g—40 to 45 inches, gray (10YR 6/1) clay; common. medium and coarse, prominent, light olive-brown (2.5YR 5/4) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; mildly alkaline, calcareous; diffuse, wavy boundary.

C—45 to 60 inches, gray (10YR 5/1) clay; common, medium and coarse, prominent, light olive-brown (2.5Y 5/4) and olive-brown (2.5Y 4/4) mottles; massive; extremely firm; mildly alkaline, calcareous.

The solum ranges from 38 to 50 inches in thickness. Depth to carbonates is the same as or slightly less than the thickness of the solum. The Ap horizon is dark-gray (10YR 4/1) or dark grayish-brown (10YR 4/2) clay or silty clay loam. The upper part of the B horizon is slightly acid or neutral, and the lower part is neutral or mildly alkaline. The B and C horizons have a hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. Mottles in these horizons have a hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 3 to 8.

Paulding soils are the very poorly drained members of a drainage sequence that includes the moderately well drained Broughton soils and the somewhat poorly drained Roselms soils. Paulding soils have finer textured B and C horizons than the Hoytville or Latty soils. They have fine-textured B and C horizons, and the A horizon is not so dark as that of the Toledo soils.

Paulding silty clay loam (Pc).—This nearly level soil is mainly near soils of secondary beach deposits, stream terraces, and local areas of sandy overwash. It generally is in long, narrow areas. This soil has a profile similar to the one described as representative for the series, but its surface layer has a lower clay content and a higher sand content. This soil is thus easier to cultivate and to drain than Paulding clay, and it generally is better suited to plants.

Included with this soil in mapping were spots of the somewhat poorly drained Roselms soils and spots of the somewhat poorly drained, coarser textured Haskins soils. Also included were spots of soils that have a silty clay surface layer.

Wetness is a severe limitation to use of this soil for farming. Seasonal wetness and very slow permeability are limitations to many nonfarm uses. Capability unit IIIw-2.

Paulding clay (Pd).—This nearly level soil is on broad flats of the lake plain. Most areas of it are large. Within these areas are a few. small, oval spots of Roselms soils that are on widely scattered slight rises. A profile of this soil is described as representative for the series. This soil is difficult to till because of its clay texture. After heavy rains, the surface layer is sticky and cloddy and a severe crust forms (fig. 4). This crust adversely affects stands of seedlings. This soil cracks readily in dry weather. It is wet, poorly aerated, and somewhat unfavorable for the penetration of plant roots.

Figure 4.—Crusting of surface soil on Paulding clay.

Included with this soil in mapping in the vicinity of South Powell Creek were a few areas of a soil similar to Paulding clay, except that it has a darker and thicker surface layer. Also, its organic-matter content is somewhat higher; and it is therefore more fertile, easier to cultivate, and easier to maintain in favorable tilth than Paulding clay. Such areas are identified by a special symbol on the soil map. Also included in mapping in some areas were spots of the somewhat poorly drained Roselms soils and in other areas spots of the coarser textured Toledo or Latty soils.

Wetness is a severe limitation to farming. Seasonal wetness, very slow permeability, and the clayey texture are limitations to many nonfarm uses. Capability unit IIIw-2.

Pewamo Series

The Pewamo series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in clay loam or silty clay loam glacial till. They are mainly on the flats and in the drainageways of the till plain south of State Route No. 12. They also occur in small widely scattered areas on the Defiance Moraine in the east-central part of the county.

In a representative profile of a Pewamo soil that is cultivated, the surface layer is 13 inches of very dark gray silty clay loam, the uppermost 9 inches of which has been plowed. The subsoil is 37 inches thick. Between depths of 13 and 18 inches, it is dark, firm silty clay mottled with yellowish brown; between depths of 18 and 36 inches, it is dark-gray, very firm clay mottled with yellowish brown; and between depths of 36 and 50 inches, it is gray, very firm clay mottled with yellowish brown. The underlying material, which begins at a depth of 50 inches and extends to a depth of 60 inches or more, is light-gray, very firm, compact, calcareous clay loam glacial till mottled with yellowish brown.

Runoff is very slow or ponded on Pewamo soils, and permeability is moderately slow. The water table is seasonally high for long periods unless the soil is artificially drained. The available water capacity is high. The root zone is deep where these soils are adequately drained. It is slightly acid to mildly alkaline.

If Pewamo soils are adequately drained, they are well suited to farming. Soybeans, corn, small grain, and hay crops are grown.

Representative profile of Pewamo silty clay loam in a cultivated field in Riley Township, SE¼SE¼ sec. 25, T. 1 S., R. 8 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silty clay loam, moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A12—9 to 13 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, subangular blocky structure; firm; 2 percent fine fragments of igneous rock and black shale; neutral; diffuse, wavy boundary.

B21tg—13 to 18 inches, dark-gray (10YR 4/1) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; thin, patchy, very dark gray (10YR 3/1) clay films on vertical and horizontal ped faces; 2 percent fine fragments of igneous rock and black shale; neutral; gradual, wavy boundary.

B22tg—18 to 36 inches, dark-gray (10YR 4/1) clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; strong, medium, subangular blocky structure; very firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; 5 percent fine and medium fragments of igneous rock and black shale; mildly alkaline; clear, irregular boundary.

B23tg—36 to 50 inches, gray (10YR 6/1) clay; many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; very firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; 5 percent fine and medium igneous and black shale fragments; mildly alkaline; clear, irregular boundary.

C—50 to 65 inches, light-gray (10YR 6/1) clay loam; many, medium and coarse, distinct, yellowish-brown (10YR 5/4) mottles; very firm; massive; glacial till; 5 percent fine and medium fragments of igneous rock and black shale; mildly alkaline, calcareous.

The solum ranges from 30 to 50 inches in thickness. The depth to carbonates generally coincides with the thickness of the solum, but in some profiles it is a few inches less. The A horizon ranges from 10 to 14 inches in thickness. It has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The upper part of the B horizon is slightly acid to neutral, and the lower part is neutral to mildly alkaline. The B2 horizon has a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. The mottles have a hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 3 to 8. Texture is clay or silty clay. The C horizon has colors similar to those of the B2 horion. Its texture is clay loam or silty clay loam.

Pewamo soils are the very poorly drained soils in a drainage sequence that has the moderately well drained Morley soils and the somewhat poorly drained Blount soils. Pewamo soils have a thicker dark-colored A horizon than the Hoytville or Toledo soils. They have finer textured B and C horizons than the Lenawee soils that formed in lacustrine materials.

Pewamo silty clay loam (Pm).—This nearly level soil is mostly on broad flats of the till plains and along upland drainageways. It commonly is near Blount soils and, less commonly, near Morley soils. On the ground moraines it generally is near the Blount soils in a mixed pattern. Where this Pewamo silty clay loam lies along upland drainageways, adequate drainage is difficult to establish in places.

Included with this soil in mapping were small areas where the slope is more than 2 percent and small areas of the somewhat poorly drained Blount soils. Also included are a few spots of the finer textured Hoytville soils.

Very poor natural drainage is the main limitation to farm use. Seasonal wetness and moderately slow permeability are limitations to many nonfarm uses. Capability unit IIw-5.

Quarries

Quarries (Qu) consists of open excavations from which limestone bedrock is mined. All overlying material, including the soil, has been removed and spread out as spoil adjacent to the excavations, or it has been used for access roadways and as fill.

Because of the nature of stripmining in this land type, the soil material in spoil banks varies within short horizontal distances. Generally the content of organic matter and available water capacity are low in the stripped soil material. This material is therefore poorly suited to the growth of plants. In most areas the stripped soil material is unstable and is subject to erosion. It is also a source of siltation.

The soil material in areas that are no longer mined need to be treated so that plants can be established to help reduce the hazard of erosion. Grasses and trees that can tolerate the low available water capacity and the unfavorable properties of the soil material are suitable for seeding and planting.

Ponded areas of this land type are generally suitable for development of wildlife habitat and recreational facilities. Not placed in a capability unit.

Rawson Series

The Rawson series consists of nearly level to sloping soils that are moderately well drained. These soils formed in loamy material that is underlain by fine-textured glacial till or lacustrine deposits at a depth of 24 to 42 inches. Rawson soils generally are on beach ridges and stream terraces.

In a representative profile of a Rawson soil that is cultivated, the surface layer is 8 inches of dark brown loam, beneath which is 3 inches of brown loam. The subsoil is 27 inches thick. The uppermost layer is 9 inches of yellowish-brown loam mottled with strong brown; the next layer is 6 inches of yellowish-brown sandy clay loam mottled with brown; next is 6 inches of dark yellowish-brown sandy clay loam mottled with grayish brown; and the lowermost layer is 6 inches of gray, very firm clay mottled with yellowish brown. The substratum, which begins at a depth of 38 inches and extends to a depth of 60 inches or more, is brown, extremely firm, heavy clay loam mottled with gray.

Runoff is slow to moderate on Rawson soils, depending on slope. These soils are moderately permeable in the surface layer and subsoil, but the substratum is very slowly permeable. They have a medium available water capacity. Their root zone is moderately deep. Below the plow layer, the upper part of the root zone commonly is very strongly acid to medium acid in the most acid layer. The lower part of the root zone is slightly acid to mildly alkaline.

Rawson soils are used primarily for corn, soybeans, small grain, and hay.

Representative profile of Rawson loam, 2 to 6 percent slopes, in a cultivated field in Sugar Creek Township, NE¼NW¼ sec. 10, T. 2 S., R. 6 E.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) loam; weak, fine, granular structure; very friable; 2 percent pebbles; medium acid; abrupt, smooth boundary.

A2—8 to 11 inches, brown (10YR 5/3) loam; weak, medium, platy structure; very friable; 2 percent pebbles; strongly acid; clear, wavy boundary.

B1t—11 to 20 inches, yellowish-brown (10YR 5/4) loam; few, fine, distinct, strong-brown (7.5YR 5/8) mottles; moderate, fine and medium, subangular blocky structure; friable; thin, yellowish-brown (10YR 5/4), patchy clay films on vertical ped faces and in pores; 5 percent pebbles; very strongly acid; clear, wavy boundary.

B21t—20 to 26 inches, yellowish-brown (10YR 5/4) sandy clay loam; few, fine, faint, brown (10YR 5/3) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; 5 percent fine pebbles; medium acid; diffuse, wavy boundary.

B22t—26 to 32 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; very firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical and horizontal ped faces; 5 percent pebbles; slightly acid; abrupt, wavy boundary.

IIB3t—32 to 38 inches, gray (10YR 6/1) clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical ped faces and along root channels; neutral; clear, wavy boundary.

IIC—38 to 60 inches, brown (10YR 5/3) heavy clay loam; many, medium, distinct, gray (10YR 5/1) mottles; massive; extremely firm; mildly alkaline, calcareous.

The solum ranges from 30 to 42 inches in thickness and commonly extends into the underlying, fine-textured material. Fine pebbles range from 2 to 10 percent in the upper part of the solum. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 3. An A2 horizon, where present, includes brown (10YR 5/3) and light yellowish-brown (10YR 6/4) colors. This horizon is loam or fine sandy loam. The upper part of the B horizon ranges from very strongly acid to medium acid. The lower part of the B horizon is medium acid to mildly alkaline. The B1t and B2t horizons have a hue of 10YR or 7.5YR, values of 4 or 5, and chroma of 3 to 6. The mottles have a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 8. Texture is loam, sandy clay loam, clay loam, or gravelly sandy clay loam. The B22t horizon has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The mottles have a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2. The texture is sandy clay loam, clay loam, or gravelly sandy clay loam. The IIB3t horizon has a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The mottles have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The texture is clay or silty clay. The IIC horizon has a hue of 10YR, value of 4 to 6, and chroma of 3 or 4. The mottles have a hue of 10YR; value of 4, 5, or 6; and chroma of 1 or 2. The IIC horizon is clay loam, silty clay, or silty clay loam.

Rawson soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Haskins and the very poorly drained Mermill soils. Rawson soils are similar to Haney soils but are underlain by fine-textured till or lacustrine material. Rawson soils are less sandy in the upper part of the solum than are Seward soils.

Rawson loam, 0 to 2 percent slopes (RmA).—This soil is mainly on slightly elevated beach ridges and on stream terraces. Most areas of this soil are oval and are near other Rawson soils and the Haskins, Haney, and Digby soils.

Included with this soil in mapping in most areas were spots of the more poorly drained Haskins soils and spots of Haney soils that are underlain by gravelly material. Also included were spots of soils that have a silt loam or sandy loam surface layer and spots of the gently sloping Rawson soils.

Limitations to farm use of this Lawson soil are few. Also, limitations are few to most nonfarm uses. Capability unit I–2.

Rawson loam, 2 to 6 percent slopes (RmB).—This soil is mainly in elongated areas that generally conform to the local relief of the beach ridges or stream terraces. A profile of this soil is described as representative for the series.

Included with this soil in mapping in many areas were spots of Haney soils that are underlain by gravelly material. Also included were spots of moderately eroded soils, spots of level soils, and spots of soils that have a fine sandy loam surface layer.

Erosion is a moderate hazard if this soil is used for farming. Limitations are few to most nonfarm uses. Capability unit IIe–1.

Rawson loam, 6 to 12 percent slopes, moderately eroded (RmC2).—This soil is in small areas, and it has short slopes. The present plow layer is a mixture of the material originally in the surface layer and some of the material in the upper part of the subsoil. This soil needs more careful management for growing plants than the less eroded Rawson soils, because it has a lower capacity to supply water to plants.

Included with this soil in most mapped areas were spots of moderately steep soils and spots of Haney soils that are underlain by gravelly material.

If this soil is used for farming, the hazard of further erosion is severe. Slope is a limitation to many nonfarm uses. Capability unit IIIe-1.

Rimer Series

The Rimer series consists of nearly level to gently sloping sandy soils that are somewhat poorly drained. These soils formed in moderately thick sandy material and in the underlying lacustrine clay or clay glacial till. The contrasting texture is within a depth of 40 inches. Rimer soils are on slight rises and on low-lying sandy ridges on the lake plain and beach ridges.

In a representative profile of a Rimer soil that is cultivated, the plow layer is dark grayish-brown loamy fine sand 9 inches thick. The subsoil is 29 inches thick. In the uppermost 13 inches, it is dark-brown loamy fine sand mottled with pale brown or yellowish brown; the next 10 inches is grayish-brown, heavy fine sandy loam mottled with dark yellowish brown; and the lowermost 6 inches is dark grayish-brown clay mottled with yellowish brown. The substratum begins at a depth of 38 inches and extends to a depth of 60 inches or more. It consists of grayish-brown, extremely firm, calcareous lacustrine clay.

Runoff is slow on Rimer soils. Permeability is rapid in the upper part of the subsoil and slow in the lower part of the subsoil and the substratum. The uppermost 20 to 40 inches of these soils commonly is saturated for long periods in winter and early in spring. These soils have low to medium available water capacity. They have a moderately deep root zone. It is mostly neutral or slightly acid, but in places it is medium acid or strongly acid.

Rimer soils are used primarily for cultivated crops, mainly corn, soybeans, and small grain.

Representative profile of Rimer loamy fine sand, 0 to 2 percent slopes, in a cultivated field in Blanchard Township, NE¼NE¼ sec. 33, T. 1 N., R. 8 E.:

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

B11—9 to 12 inches, dark-brown (10YR 4/3) loamy fine sand; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

B12—12 to 22 inches, dark-brown (10YR 4/3) loamy fine sand; common, medium, distinct, pale-brown (10YR 6/3) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; medium acid; abrupt, wavy boundary.

B21t—22 to 32 inches, grayish-brown (10YR 5/2) heavy fine sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; weak, medium and coarse, subangular blocky structure; friable; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal faces of peds, and bridging between sand grains; few iron and manganese stains; neutral; abrupt, wavy boundary.

IIB22t—32 to 38 inches, dark grayish-brown (10YR 4/2) clay; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical faces of peds and along root channels; neutral; diffuse, wavy boundary.

IIC—38 to 60 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; extremely firm; moderately alkaline, calcareous lacustrine material.

The solum ranges from 24 to 44 inches in thickness, which commonly coincides with the depth to carbonates, but in places several inches of the lower part of the solum are slightly calcareous. The depth to fine-textured material in the IIB or IIC horizons ranges from about 22 to 40 inches, but it is most commonly about 30 inches.

The Ap horizon has a hue of 10YR, value of 3 to 5, and chroma of 2. The B horizon ranges from strongly acid to slightly acid in the upper part and from slightly acid to mildly alkaline in the lower part. The B1 horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The B2 horizon has a hue of 10YR, value of 4 to 6, and chroma of 2. The mottles have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. This horizon is sandy loam, fine sandy loam, and sandy clay loam in texture. The IIB horizon has a hue of 10YR, value of 4 or 5, and chroma of 4 to 6. Its texture ranges from clay to heavy clay loam. The IIC horizon has a hue of 10YR, value of 5 or 6, and chroma of 1 or 2. Mottles in this horizon have a hue of 10YR, value of 4 or 5, and chroma of 4 to 6. The texture ranges from clay to silty clay loam.

Rimer soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Seward soils and the very poorly drained Wauseon soils. Rimer soils differ from the somewhat poorly drained Tedrow soils in that they are clayey in the lower part of the solum and in the C horizon, whereas Tedrow soils are underlain by calcareous sand. Rimer soils have a coarser textured B horizon above the clayey lower part of the solum and the C horizon than do the Haskins soils.

Rimer loamy fine sand, 0 to 2 percent slopes (RnA).—This soil is in small, oval areas, most of which are adjacent to the deeper sandy Tedrow and Ottokee soils. This soil generally is downslope from the Tedrow and Ottokee soils and between those soils and the clayey lake plain soils, such as Hoytville, Paulding, or Toledo. A profile of this soil is described as representative for the series. Seepage from soils on adjacent side slopes is more noticeable in this soil than in the more sloping Rimer soils.

Included with this soil in mapping were spots of deep, sandy Tedrow soils and spots of the somewhat finer textured Haskins soils. Also included were a few small areas of moderately well drained soils.

Seasonal wetness is a moderate limitation to use of this soil for farming; droughtiness is also a limitation. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw-3.

Rimer loamy fine sand, 2 to 6 percent slopes (RnB).—This soil is on rises on the lake plain, where it is adjacent to deeper sandy soils, such as Tedrow and Ottokee and to soils of the lake plain, such as Hoytville, Nappanee, and Toledo. Also, it is on some of the flanks of beach ridges and stream terraces. Areas of this soil range from oval to long and narrow. Excessive seepage is a concern where this soil is near the base of ridges, downslope from better drained sandy soils.

Included with this soil in mapping were a few spots of moderately well drained soils and a few spots of the somewhat finer textured Haskins soils. Spots of deep, sandy Tedrow soils were also included.

Seasonal wetness is a moderate limitation to use of this soil for farming; droughtiness and susceptibility to erosion are also limitations. Seasonal wetness and slow permeability are limitations to many nonfarm uses. Capability unit IIw-3.

Roselms Series

The Roselms series consists of nearly level to gently sloping soils that are somewhat poorly drained. These soils formed in lacustrine clay sediment on the lake plain.

In a representative profile of a Roselms soil that is cultivated, the plow layer is grayish-brown silty clay loam 6 inches thick. The subsoil is 22 inches thick. The uppermost layer is 6 inches of dark-gray clay mottled with dark yellowish brown and brown; the next layer is 6 inches of dark-gray clay mottled with dark yellowish brown and yellowish brown; below this is 6 inches of brown clay mottled with dark gray; and the lowermost layer is 4 inches of gray clay mottled with dark yellowish brown. The substratum, which begins at a depth of 28 inches and extends to a depth of 60 inches or more, is gray, calcareous clay mottled with brown.

Runoff is slow to medium on Roselms soils, and permeability is very slow. These soils are seasonally saturated with water for long periods. They dry out slowly in spring. Available water capacity is medium. The root zone is moderately deep. It ranges from strongly acid to mildly alkaline.

Roselms soils are used mostly for soybeans, corn, small grain, and hay.

Representative profile of Roselms silty clay loam, 0 to 2 percent slopes, in a cultivated field in Greensburg Township, NW¼SW¼ sec. 19, T. 1 N., R. 7 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silty clay loam; weak, fine and medium, granular structure; friable; medium acid; abrupt, smooth boundary.

B21tg—6 to 12 inches, dark-gray (10YR 4/1) clay; many medium, distinct, dark yellowish-brown (10YR 4/4) and brown (10YR 4/3) mottles; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; strongly acid; clear, wavy boundary.

B22tg—12 to 18 inches, dark-gray (10YR 4/1) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; firm; thin, patchy, gray (10YR 5/1) clay films on vertical and horizontal ped faces; slightly acid; diffuse, wavy boundary.

B23tg—18 to 24 inches, brown (10YR 4/3) clay; many, medium, distinct, dark-gray (10YR 4/1) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; very firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces; neutral; gradual, wavy boundary.

B3tg—24 to 28 inches, gray (10YR 5/1) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to weak, fine, subangular blocky; very firm; thin, patchy, dark-gray (10YR 4/1) clay films on vertical ped faces and continuously along old root channels; mildly alkaline; calcareous; clear, wavy boundary.

C—28 to 60 inches, gray (10YR 5/1) clay; many, medium, distinct, brown (10YR 4/3) mottles; massive; extremely firm; moderately alkaline, calcareous lacustrine sediment.

The solum ranges from 18 to 30 inches in thickness but it generally is about 22 inches thick. The depth to carbonates commonly coincides with the thickness of the solum, but in places it is a few inches less. The Ap horizon is dark grayish-brown (10YR 4/2) or grayish-brown (10YR 5/2) silt loam or silty clay loam. The B horizon ranges from strongly acid to neutral in the upper part and from neutral to mildly alkaline in the lower part. The B21 and B22 horizons have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Their mottles have a hue of 10YR or 7.5 YR, value of 4 or 5, and chroma of 3 to 6. The B23 horizon has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The mottles are in a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The B3 and C horizons have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Mottles in these horizons have a hue of 10YR, value of 4 to 6, and chroma of 3 or 4.

Roselms soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Broughton soils and the very poorly drained Paulding soils. Roselms soils differ from Nappanee soils in having a higher content of clay in the B horizon and in having formed in lacustrine sediment rather than glacial till. Roselms soils have a higher content of clay in the B horizon than Fulton soils.

Roselms silt loam, 0 to 2 percent slopes (RoA).—This soil generally is on slight rises on the lake plain. The areas are oval or somewhat elongated, and they are generally surrounded by large areas of Paulding soils. This soil has a profile similar to the one described as representative for the series, but its surface layer is less clayey. This soil is thus easier to cultivate and to maintain in favorable tilth than Roselms silty clay loam, 0 to 2 percent slopes.

Included with this soil in mapping were a few areas of soils that have a loam surface layer. Also included were spots of slightly steeper soils and spots of coarser textured Fulton soils.

Soil wetness is a severe limitation to use of this soil for farming. Seasonal wetness, very slow permeability, and a high clay content are limitations to most nonfarm uses. Capability unit IIIw-1.

Roselms silt loam, 2 to 6 percent slopes (RoB).—This soil is mainly in upland areas adjacent to streams and drainageways. Slopes are near the low end of the slope range in most places. The areas of this soil are elongated and are adjacent to areas of the Broughton and Paulding soils and also to soils of the flood plains. This soil has a profile similar to the one described as representative for the series, but its surface layer is less clayey. This soil is thus easier to cultivate and to keep in favorable tilth than Roselms silty clay loam, 0 to 2 percent slopes.

Included with this soil in mapping were a few areas of soils that have a loam surface layer. Also included were spots of slightly less sloping soils and spots of moderately well drained Broughton soils.

Wetness is a severe limitation to use of this soil for farming. Seasonal wetness, very slow permeability, and a high content of clay are limitations to most nonfarm uses. Capability unit IIIw-1.

Roselms silty clay loam, 0 to 2 percent slopes (RsA).—This soil is on slight rises of the lake plain, commonly adjacent to Paulding soils. The areas generally are oval or slightly elongated and are surrounded by Paulding soils in most places. A profile of this soil is described as representative for the series. The soil is difficult to till because the surface layer is sticky and tends to be cloddy. Also, serious crusting occurs after periods of heavy rainfall.

Included with this soil in mapping, in the upper reaches of South Powell Creek, were a few areas of soils that have a darker colored surface layer. Such areas are identified by a symbol on the soil map. Also included were a few areas of soils that have a clay surface layer and a few spots of slightly steeper soils.

Wetness is a severe limitation to use of this soil for farming. Seasonal wetness, a high clay content, and very slow permeability are limitations to most nonfarm uses. Capability unit IIIw–1.

Roselms silty clay loam, 2 to 6 percent slopes (RsB).—This soil is mostly along the valley sides or uplands adjacent to streams that flow through the lake plain. The areas are long and narrow in most places, and most slopes are near the low end of the slope range. This soil generally is adjacent to Broughton soils, Paulding soils, other Roselms soils, and to soils of the flood plains.

Included with this soil in mapping were a few spots of moderately eroded soils and a few spots of moderately well drained Broughton soils. Also included were a few areas of soils that have a clay surface layer.

Wetness is a severe limitation to use of this soil for farming. Seasonal wetness, a high clay content, and very slow permeability are limitations to most nonfarm uses. Capability unit IIIw–1.

St. Clair Series

The St. Clair series consists of gently sloping to moderately steep soils that are moderately well drained. These soils formed in clay loam or clay glacial till. They are commonly on the sides of valleys adjacent to streams that flow through the lake plain.

In a representative profile of a St. Clair soil that is cultivated, the plow layer is brown silt loam 6 inches thick. The subsoil is 20 inches thick. The uppermost 6 inches is brown clay mottled with dark yellowish brown; the next 5 inches is dark yellowish-brown clay mottled with yellowish brown; and the lowermost 9 inches is dark yellowish-brown clay mottled with grayish brown. The substratum, which extends from a depth of 26 inches to a depth of 60 inches or more, is dark grayish-brown, calcareous glacial till clay mottled with brown.

Runoff is moderate to rapid on St. Clair soils, depending on slope. Permeability is very slow. These soils are seasonally saturated with water for short periods. Available water capacity is medium. The root zone is moderately deep. It is medium acid to mildly alkaline.

The gently sloping St. Clair soils are principally used for cultivated crops, but the steeper ones are mostly in woodland or pasture.

Representative profile of St. Clair silt loam, 2 to 6 percent slopes, in a cultivated field in Monterey Township, SW¼NW¼ sec. 36, T. 1 S., R. 4 E.:

Ap—0 to 6 inches, brown (10YR 5/3) silt loam; weak, fine and medium, granular structure; very friable; 2 percent small fragments of black shale, chert, and igneous pebbles; medium acid; abrupt, smooth boundary.

B21t—6 to 9 inches, brown (10YR 4/3) clay; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, fine and medium, subangular blocky structure; very firm; few, thin, patchy dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; 2 percent fine fragments of black shale, chert, and igneous pebbles; medium acid; clear, smooth boundary.

B22t—9 to 12 inches, brown (10YR 4/3) clay; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, fine and medium, subangular blocky structure; very firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical and horizontal ped faces; 2 percent fine fragments of black shale, chert, and igneous material; neutral; gradual, smooth boundary.

B23t—12 to 17 inches, dark yellowish-brown (10YR 4/4) clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; very firm; 2 percent fine fragments of black shale, chert, and igneous material; mildly alkaline; clear, smooth boundary.

B3t—17 to 26 inches, dark yellowish-brown (10YR 4/4) clay; many, medium, distinct grayish-brown (10YR 5/2) mottles; moderate, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; very firm; 2 percent fine fragments of black shale, chert, and igneous material; few, thin, patchy, brown (10YR 4/3) clay films on vertical ped faces and along root channels; mildly alkaline, calcareous; clear, smooth boundary.

C—26 to 60 inches, dark grayish-brown (10YR 4/2) clay; few, fine, faint, brown (10YR 4/3) mottles; weak, medium, subangular blocky structure grading to massive with depth; extremely firm; moderately alkaline, calcareous; glacial till.

The solum ranges from 20 to 28 inches in thickness, but it is generally about 20 inches thick. In many places, much of the material in the solum has been lost through erosion. The depth to carbonates generally coincides with the depth of the solum, but in some places the solum extends into the calcareous material for several inches. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is either loam or silt loam. The B horizon ranges from medium acid to mildly alkaline. The B2 horizon has a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Its mottles have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The B3 horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Its mottles have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Texture of both the B3 and the C horizons is clay or silty clay.

The lower part of the solum is calcareous, which is outside the range defined for the series, but this difference does not alter the usefulness or the behavior of these soils.

St. Clair soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Nappanee soils and the very poorly drained Hoytville soils. St. Clair soils are adjacent to darker colored Latty soils also. They differ from Morley soils in having finer textured B and C horizons. They differ from Broughton soils in being coarser textured throughout the profile.

St. Clair loam, 2 to 6 percent slopes (ScB).—This soil most commonly is adjacent to soils of the stream terraces. Most areas are long and narrow. This soil has a profile similar to the one described as representative for the series, but its surface layer is sandier and is 10 to 12 inches thick. This soil is thus easier to cultivate than St. Clair silt loam, 2 to 6 percent slopes. Also, a crust forms on the surface less readily.

Included with this soil in mapping were a few spots of moderately eroded soils and a few spots of slightly steeper soils. Also included were a few spots of the coarser textured Rawson soils.

A severe erosion hazard is the major limitation to use of this St. Clair soil for farming. Very slow permeability and slope are limitations to some nonfarm uses. Capability unit IIIe–2.

St. Clair silt loam, 2 to 6 percent slopes (ScB).—This soil commonly is along valley sides adjacent to streams that flow through the lake plain. The areas are long and narrow in most places. A profile of this soil is described as representative for the series. This soil generally is near Hoytville, Nappanee, and Latty soils and also near soils of the flood plains.

Included with this soil in mapping were areas of a moderately eroded soil that has a silty clay loam surface layer. Slopes of this included soil commonly are near the high end of the slope range. Also included were spots of the more poorly drained Nappanee soils and spots of slightly steeper soils.

A severe erosion hazard is the major limitation to use of this soil for farming. Very slow permeability and slope are limitations to some nonfarm uses. Capability unit IIIe-2.

St. Clair silt loam, 6 to 12 percent slopes, moderately eroded (ScC2).—This soil is on valley sides adjacent to streams that flow through the lake plain. Generally this soil is in long, narrow areas on the breaks of slopes between the uplands and the flood plains. Most of these areas are too short and too narrow to be farmed or managed separately; thus, they commonly are incorporated into fields that are made up of soils on bottom lands and uplands. The present surface layer is a mixture of silt loam from the original surface layer and clay from the subsoil. Farming practices are the same for this soil as they are for the nearby gently sloping or nearly level soils.

Included with this soil in mapping were areas of uneroded St. Clair silt loam, 6 to 12 percent slopes, commonly in woods or pasture. Also included were a few spots of St. Clair silt loam, 12 to 18 percent slopes, moderately eroded; a few areas of soils that have a silty clay loam surface layer; and a few spots of soils where the thickness of the surface layer and the subsoil together is slightly less than 20 inches.

A very severe erosion hazard is the major limitation to use of this soil for cultivated crops. Slope and very slow permeability are limitations to many nonfarm uses. Capability unit IVe-1.

St. Clair silt loam, 12 to 18 percent slopes, moderately eroded (ScD2).—This soil is on valley walls adjacent to streams that flow through the lake plain. This soil generally is not cultivated, because slopes are short and too steep. This soil commonly is adjacent to other St. Clair soils and to soils of the flood plains. The present surface layer is a mixture of silt loam from the original surface layer and clay from the subsoil.

Included with this soil in mapping were spots of slightly less sloping soils and spots of severely eroded St. Clair soils. Also included were a few spots of soils where the thickness of the surface layer and the subsoil together is slightly less than 20 inches.

A very severe erosion hazard is the major limitation to use of this soil for farming. Slope, very slow permeability, and susceptibility to further erosion are limitations to many nonfarm uses. Capability unit VIe-1.

Seward Series

The Seward series consists of nearly level to gently sloping, sandy soils that are moderately well drained. These soils formed partly in moderately thick sandy material and partly in the underlying lacustrine clay or glacial till clay. They are on the sandy ridges of the lake plain.

In a representative profile of a Seward soil that is cultivated, the plow layer is 8 inches of dark grayish-brown loamy fine sand. The subsoil is 30 inches thick. The uppermost 20 inches is yellowish-brown loamy fine sand mottled with pale brown; the next 6 inches is pale-brown, heavy fine sandy loam mottled with yellowish brown; and the lowermost 4 inches is dark grayish-brown very firm clay mottled with yellowish brown. The substratum, which begins at a depth of 38 inches and extends to a depth of 60 inches or more, is grayish-brown clay mottled with dark yellowish brown.

Runoff is slow on Seward soils. Permeability is rapid in the coarse-textured material in the upper part of the profile and slow in the underlying clayey material. Available water capacity is low to medium. The root zone is moderately deep and strongly acid to neutral.

Seward soils are used mostly for corn, soybeans, and small grain.

Representative profile of Seward loamy fine sand, 2 to 6 percent slopes, in a cultivated field in Blanchard Township, SW¼NE¼ sec. 19, T. 1 N., R. 8 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B11—8 to 16 inches, yellowish-brown (10YR 5/4) loamy fine sand; very weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

B12—16 to 28 inches, yellowish-brown (10YR 5/4) loamy fine sand; common, medium, distinct, pale-brown (10YR 6/3) mottles; single grain; loose; medium acid; abrupt, wavy boundary.

B2t—28 to 34 inches, pale-brown (10YR 6/3) heavy fine sandy loam; few, fine, faint, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on ped faces, and bridging between sand grains; neutral; abrupt, wavy boundary.

IIB3t—34 to 38 inches, dark grayish-brown (10YR 4/2) clay; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very firm; thin, patchy, dark grayish-brown (10YR 4/2) clay films on vertical ped faces and along root channels; neutral; diffuse, wavy boundary.

IIC—38 to 60 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; extremely firm; moderately alkaline, calcareous lacustrine sediment.

The solum ranges from 38 to 48 inches in thickness. This generally coincides with the depth to carbonates, but in places several inches of the lower part of the solum is calcareous. The depth to fine-textured material (IIB or IIC horizons) ranges from 24 to 40 inches, but it commonly is at a depth of about 35 inches. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The upper part of the B horizon is medium acid or slightly acid, but the lower part ranges from slightly acid to mildly alkaline. The B1 and B2 horizons have a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The mottles are 10YR or 7.5YR in hue, 4 to 6 in value, and 3 to 6 in chroma. Texture of the B2 horizon ranges from sandy loam to sandy clay loam. The IIB3 and IIC horizons have a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. Mottles in these horizons have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The texture is clay.

Seward soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Rimer soils and the very poorly drained Wauseon soils. Seward soils differ from Ottokee soils in having a finer texture in the lower part of the solum and in the underlying clayey substratum, whereas Ottokee soils formed in thick sands. Seward soils are coarser textured in the upper part of the solum than are the similar Rawson soils.

Seward loamy fine sand, 0 to 2 percent slopes (SdA).—This soil is on slightly elevated, sandy ridges on the lake plain. The areas are oval in most places and are near the high end of the slope range.

Included with this soil in mapping were spots of slightly steeper soils, spots of the deep, sandy Ottokee soils, and a few spots of the finer textured Rawson soils. Also included were a few areas of soils that have a surface layer of fine sandy loam.

A moderate hazard of erosion is the major limitation to use of this soil for farming; droughtiness is also a limitation. Slow permeability in the lower part of this soil is a limitation to some nonfarm uses. Capability unit IIe-2.

Seward loamy fine sand, 2 to 6 percent slopes (SdB).—This soil is mainly on sandy ridges of the lake plain and on the moraine. Commonly, this soil is adjacent to deeper sandy soils, such as the Tedrow and Ottokee soils, and to shallow sandy soils, such as Rimer soils. The areas generally are long and narrow, but in places they are oval. A profile of this soil is described as representative for the series.

Included with this soil in mapping were areas of soils that have a surface layer of fine sandy loam. Also included were spots of soils that have slightly less slope or slightly greater slope than this soil, spots of the deep sandy Ottokee soils, and a few spots of the finer textured Rawson soils.

A moderate hazard of erosion is the major limitation to use of this Seward soil for farming. Droughtiness is also a limitation. Slope and slow permeability are limitations to some nonfarm uses. Capability unit IIe-2.

Shinrock Series

The Shinrock series consists of gently sloping to sloping soils that are moderately well drained. These soils formed in loamy material overlying mostly stratified clayey material that was deposited at the bottom of former glacial lakes. Shinrock soils are on the valley sides of streams that flow through the lake plain. Some areas are also on the moraine.

In a representative profile of a Shinrock soil that is cultivated, the plow layer is dark grayish-brown silt loam 8 inches thick. The subsurface layer is pale-brown silt loam 4 inches thick. The subsoil is 19 inches thick. Between depths of 12 and 20 inches it is yellowish-brown silty clay loam, and between depths of 20 and 31 inches it is strong-brown silty clay mottled with light brownish gray. The substratum, which begins at a depth of 31 inches and extends to a depth of 60 inches or more, is stratified silty clay loam, silty loam, and silty clay mottled with grayish brown.

Runoff on Shinrock soils is moderate to rapid, depending on slope. Available water capacity is medium. Permeability is moderately slow. The root zone is moderately deep. Below the plow layer, the root zone commonly is slightly acid to medium acid in the most acid layer. Below the root zone, these soils grade to mildly alkaline as depth increases.

Shinrock soils are used primarily for corn, soybeans, small grain, and hay. The sloping areas are used mostly for pasture or trees.

Representative profile of Shinrock silt loam, 2 to 6 percent slopes, in a cultivated field in Blanchard Township, SE¼SE¼ sec. 28, T. 1 N., R. 8 E.:

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

A2—8 to 12 inches, pale-brown (10YR 6/3) silt loam; very weak, thick, platy structure; friable; medium acid; clear, wavy boundary.

B21t—12 to 20 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; thin, patchy, pale-brown (10YR 6/3) clay films on vertical ped faces; slightly acid; diffuse, wavy boundary.

B22t—20 to 31 inches, strong-brown (7.5YR 5/6) silty clay; common, fine and medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; very firm; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal ped faces; slightly acid; clear, wavy boundary.

C—31 to 60 inches, brown (7.5YR 5/4) stratified silty clay loam, silt loam, and silty clay; many, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; firm; mildly alkaline, calcareous lacustrine material.

The solum ranges from 20 to 40 inches in thickness. This commonly coincides with the depth to carbonates. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The A2 horizon has a hue of 10YR, value of 4 to 6, and chroma of 3. The A2 horizon is slightly acid to strongly acid. The B horizon ranges from medium acid to slightly acid in the upper part and from slightly acid to neutral in the lower part. The B2 horizon has a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. Mottles in the B22t horizon have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Texture of the B2 horizon ranges from silty clay to clay loam. The C horizon has a hue of 7.5YR, value of 4 or 5, and chroma of 2 to 6. The mottles have a hue of 10YR, value of 5 or 6, and chroma 1 or 2.

Shinrock soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Del Rey soils and the very poorly drained Lenawee soils. Shinrock soils have less clay in the B and C horizons than Lucas soils, but they have more clay in the B and C horizons than Tuscola soils.

Shinrock silt loam, 2 to 6 percent slopes (SfB).—Most areas of this soil are long and narrow, but a few are oval. A profile of this soil is described as representative for the series.

Included with this soil in mapping in many areas were spots of coarser textured Tuscola or somewhat poorly drained Del Rey soils. Also included were spots of soils that have a surface layer of loam and other spots of moderately eroded soils.

Erosion is a moderate hazard if this soil is farmed. Limitations to most nonfarm uses are few. Capability unit IIe-3.

Shinrock silt loam, 6 to 12 percent slopes, moderately eroded (SfC2).—This soil is in long, narrow areas. Most slopes are short. The present plow layer is a mixture of the material originally in the surface layer and a part of material in the subsoil. This soil needs more careful management for growing plants than the uneroded Shinrock soils because it has a lower capacity to absorb and supply water to plants.

Included with this soil in mapping in many areas were spots of gently sloping soils, and other spots of moderately steep or steep soils.

If this soil is used for farming, further erosion is a severe hazard. Slope is a limitation to some nonfarm uses. Capability unit IIIe-2.

Shoals Series

The Shoals series consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy recent alluvium. They are on flood plains.

In a representative profile of a Shoals soil that is cultivated, the plow layer is grayish-brown silt loam 8 inches thick. The upper part of the subsoil, which extends to a depth of 16 inches, is grayish-brown silt loam mottled with yellowish brown; and the lower part, which extends to a depth of 28 inches, is yellowish-brown silt loam mottled with grayish brown and dark yellowish brown. The substratum extends to a depth of 60 or more inches and is grayish-brown, stratified, calcareous silt loam and fine sandy loam mottled with yellowish brown.

Runoff is very slow on Shoals soils, and permeability is moderate. Available water capacity is high. Artificial drainage generally is needed in most areas; however, an adequate tile system that has suitable outlets is difficult to install because of the position of these soils in relation to streams. The root zone is deep. It is slightly acid to mildly alkaline.

Shoals soils are used primarily for cultivated crops or for pasture.

Representative profile of Shoals silt loam, in a cultivated field in Union Township, NE¼SE¼ sec. 20, T. 1 S., R. 6 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam; moderate, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.

B21g—8 to 16 inches, grayish-brown (10YR 5/2) heavy silt loam; many, coarse, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; neutral; diffuse, wavy boundary.

B22g—16 to 28 inches, yellowish-brown (10YR 5/4) silt loam; many, coarse, distinct, grayish-brown (10YR 5/2) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

Cg—28 to 60 inches, grayish-brown (10YR 5/2) stratified silt loam and fine sandy loam; many, coarse, distinct, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; massive; friable; small pockets of sand and fine gravel in places below a depth of 30 inches; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness, but it commonly is 25 to 35 inches thick. The Ap horizon has a hue of 10YR, value of 4 to 6, and chroma of 2 or 3. The B horizon is slightly acid to neutral in the upper part and neutral to mildly alkaline in the lower part. The B21 horizon has a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. Mottles in this horizon have a hue of 10YR, value of 4 or 5, and chroma of 3 to 6. Texture in the B2 horizon is silt loam or silty clay loam. The B22 horizon has the same hue and value as the B21 horizon, but the chroma is 4 to 6. The mottles have a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The C horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The upper part of this horizon is silt loam and fine sandy loam.

Shoals soils are the somewhat poorly drained members of a drainage sequence that includes the well-drained Genesee soils and the very poorly drained Sloan soils. Shoals soils are less clayey in the B and C horizons than Defiance soils.

Shoals silt loam (Sh).—This nearly level soil generally occupies elevated positions on flood plains of the major streams and their tributaries between areas of Genesee soils and Sloan soils. It commonly is adjacent to Sloan soils. In places it is next to Wabasha soils.

Included with this soil in many mapped areas were small spots of soils that have a loam surface layer or spots of soils that have a silty clay loam surface layer. Also included were a few spots of finer textured Defiance soils and a few spots of poorly drained Sloan soils.

Susceptibility to flooding and a seasonally high water table are limitations to most uses of this soil. Capability unit IIw-1.

Shoals Series, Moderately Shallow Variant

The Shoals series, moderately shallow variant, consists of nearly level soils that are somewhat poorly drained. These soils formed in loamy recent alluvium over limestone bedrock, which occurs at a depth of 20 to 40 inches. They are in an area along Riley Creek between the village of Pandora and the Allen County line.

In a representative profile in an area that is cultivated, the plow layer is dark yellowish-brown silt loam 8 inches thick. The subsoil, between depths of 8 and 22 inches, is dark grayish-brown silty clay loam mottled with yellowish brown. The lower part of the subsoil, which extends to a depth of 27 inches, is dark yellowish-brown silty clay loam mottled with yellowish brown. The subsoil rests on limestone bedrock.

Shoals soils, moderately shallow variant, have moderate permeability and medium available water capacity. The root zone is moderately deep. It is slightly acid to mildly alkaline.

These soils are used primarily for cultivated crops.

Representative profile of Shoals silt loam, moderately shallow variant, in a cultivated field in Riley Township, SW¼SE¼ sec. 29, T. 1 S., R. 8 E.:

Ap—0 to 8 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, very coarse, granular structure; very friable; neutral; abrupt, smooth boundary.

B21—8 to 16 inches, dark grayish-brown (10YR 4/2) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, very coarse, platy structure parting to moderate, coarse, subangular blocky, firm; slightly acid; clear, smooth boundary.

B22—16 to 22 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, coarse, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; neutral; smooth, wavy boundary.

B23—22 to 27 inches, dark yellowish-brown (10YR 4/4) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, coarse, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

R—27 inches, limestone bedrock.

The depth to the limestone bedrock ranges from 20 to 40 inches, but it commonly is about 30 inches. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2, 3, or 4. The B21 and B22 horizons have a hue of 10YR, value of 4 or 5, and chroma of 2. The B23 horizon has a hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The mottles have a hue of 10YR, value of 4 or 5, and chroma of 4 to 6.

This soil is near Digby loam, moderately shallow variant, which occurs on stream terraces. It is also near the poorly drained, deep Sloan soils on flood plains.

Shoals silt loam, moderately shallow variant (Sk).—This nearly level soil is in an area along Riley Creek between the village of Pandora and the Allen County line. It is subject to flooding. It is somewhat droughty because it is shallow to bedrock.

Included with this soil in mapping were a few spots of soils where bedrock is at a depth of 16 to 20 inches.

A seasonal high water table is a moderate limitation to use of this soil for farming. Seasonal wetness and shallowness are limitations to many nonfarm uses. Capability unit IIw-1.

Sloan Series

The Sloan series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in loamy-textured recent alluvium. They are on flood plains. Sloan soils are subject to flooding in periods of high water, primarily in winter, but flooding can occur in any season.

In a representative profile of a Sloan soil that is cultivated, the surface layer is 14 inches of very dark gray silty clay loam, the upper part of which is a plow layer about 8 inches thick. The subsoil is 30 inches thick. The upper part is 10 inches of grayish-brown silty clay loam mottled with yellowish brown, and the lower part is 20 inches of gray silty clay loam mottled with dark yellowish brown. The substratum extends from a depth of 44 inches to a depth of 70 inches or more. It is gray, stratified silty clay loam, loam, and sandy loam calcareous alluvium that is mottled with yellowish brown and brownish yellow.

Runoff is slow, and permeability is moderate. Sloan soils have a seasonal high water table for long periods in winter and in spring. Available water capacity is high. The root zone is deep if these soils are adequately drained. It is neutral or mildly alkaline.

Sloan soils are used mainly for corn and soybeans, but a few areas are used for meadow.

Representative profile of Sloan silty clay loam, in a cultivated field in Union Township, SW¼SW¼ sec. 22, T. 1 S., R. 6 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; neutral; abrupt, smooth boundary.

A12—8 to 14 inches, very dark gray (10YR 3/1) silty clay loam; moderate, fine and medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

B21g—14 to 24 inches, grayish-brown (10YR 5/2) silty clay loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; neutral; diffuse, wavy boundary.

B22g—24 to 36 inches, gray (10YR 5/1) silty clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

B3g—36 to 44 inches, gray (10YR 5/1) silty clay loam; many, medium, dark yellowish-brown (10YR 4/4) mottles; massive; firm; neutral; clear, irregular boundary.

Cg—44 to 70 inches, gray (10YR 5/1) stratified alluvium consisting of silty clay loam, silt loam, loam, and sandy loam; common, coarse, distinct, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/6) mottles; massive; friable; moderately alkaline, calcareous.

The solum ranges from 40 to 50 inches in thickness. The A horizon ranges from 11 to 15 inches in thickness. The depth to carbonates commonly coincides with the thickness of the solum, but in places the C horizon is noncalcareous to a depth of 1 foot or more. Reaction in the solum is neutral to moderately alkaline. The A horizon has a hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The B2 horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The mottles have a hue of 10YR, value of 4 or 5, and chroma of 4 to 6. The B3 and C horizons have a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The mottles in these horizons have a hue of 10YR, and a value and chroma of 4 to 6.

Sloan soils are the very poorly drained members of a drainage sequence that includes the well-drained Genesee soils and the somewhat poorly drained Shoals soils. They are adjacent to these soils in many places. Sloan soils are less clayey in the B horizon than the very poorly drained Wabasha soils.

Sloan silty clay loam (So).—This nearly level soil is on low-lying flood plains along the major streams and their tributaries, including abandoned stream channels and oxbows.

Included with this soil in mapping were some areas of soils that have a silt loam surface layer and a few spots of lighter colored Shoals soils.

Susceptibility to flooding and very poor natural drainage are the major limitations to use of this soil for farm and nonfarm purposes. Capability unit IIIw-3.

Tedrow Series

The Tedrow series consists of nearly level soils that are somewhat poorly drained. These soils formed in deep lacustrine sands, and they commonly are on slight rises of the lake plain.

In a representative profile of a Tedrow soil that is cultivated, the plow layer is very dark grayish-brown loamy fine sand 9 inches thick. The subsoil is 35 inches thick. The upper layer is 7 inches of dark grayish-brown, loamy fine sand mottled with dark yellowish brown. The lower 28 inches of the subsoil is grayish-brown sand mottled with yellowish brown. The substratum, which begins at a depth of 44 inches and extends to a depth of 72 inches or more, is light brownish-gray loamy sand mottled with yellowish brown.

Runoff is slow on Tedrow soils, and permeability is rapid. These soils are saturated with water for short periods in winter and in spring. Available water capacity is low. The root zone is deep when the water table is low. The upper part of the root zone is slightly acid to neutral.

Tedrow soils are used mainly for corn, soybeans, and small grain. Most of the cultivated acreage has been artificially drained for improved plant growth and more timely tillage.

Representative profile of Tedrow loamy fine sand, 0 to 3 percent slopes, in Blanchard Township, SE¼NW¼ sec. 14, T. 1 N., R. 8 E.:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; very weak, fine and medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B21—9 to 16 inches, dark grayish-brown (10YR 4/2) loamy fine sand; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; slightly acid; clear, smooth boundary.

B22—16 to 25 inches, grayish-brown (10YR 5/2) sand; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain, loose; slightly acid; clear, wavy boundary.
B23—25 to 44 inches, grayish-brown (10YR 5/2) sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; mildly alkaline; diffuse, wavy boundary.
C—44 to 72 inches, light brownish-gray (10YR 6/2) loamy sand; common, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; moderately alkaline, calcareous.

The solum ranges from 36 to 50 inches in thickness, but it commonly is about 40 inches. This commonly coincides with the depth to carbonates. The Ap horizon has a hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The B and C horizons have a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 2. Mottles in these horizons have a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 4 or 6. The texture is loamy sand or sand.

The B horizon has gray colors that are outside the range defined for the series, but this difference does not alter the usefulness or behavior of Tedrow soils.

Tedrow soils are the somewhat poorly drained members of a drainage sequence that includes the moderately well drained Ottokee soils. They are commonly adjacent to those soils, as well as to Seward, Rimer, and Arkport soils. Tedrow soils differ from the somewhat poorly drained Rimer soils in not having fine-textured material in the lower part of the solum and in the C horizon. Tedrow soils are coarser textured than the similar Kibbie soils. They are more poorly drained than Seward or Arkport soils.

Tedrow loamy fine sand, 0 to 3 percent slopes (TdA).—Most areas of this soil are irregular or oval in shape. A few areas are long and narrow.

Included with this soil in mapping were some areas of soils that have a sandy loam surface layer and other areas of slightly steeper soils. Also included were spots of finer textured Kibbie soils and a few spots of better drained Ottokee soils.

Seasonal wetness is a moderate limitation to use of this soil for farming, and droughtiness is also a concern in summer after extended periods of dry weather. Seasonal wetness and rapid permeability are limitations to some nonfarm uses. Capability unit IIw-3.

Toledo Series

The Toledo series consists of dark-colored, nearly level soils that are very poorly drained. These soils formed in lacustrine clayey sediment. They are on the broad flats of the lake plain and in the more poorly drained areas on the Defiance moraine in the east-central part of the county.

In a representative profile of a Toledo soil that is cultivated, the plow layer is very dark grayish-brown silty clay 8 inches thick. The subsoil is 47 inches of dark-gray or gray, firm or very firm silty clay mottled with yellowish red, brownish yellow, yellowish brown, and strong brown. The substratum, which begins at a depth of 55 inches and extends to a depth of 80 inches or more, is yellowish-brown lacustrine silty clay loam that is calcareous and very firm or extremely firm.

Runoff is very slow on Toledo soils, and permeability is slow. These soils are saturated with water for long periods in winter and in spring. They have medium available water capacity. The root zone is deep when the water table is low. The root zone is mostly neutral in reaction.

Toledo soils are mainly used for corn, soybeans, and small grain. Much of the acreage of these soils has been artificially drained for improved plant growth and more timely tillage.

Representative profile of Toledo silty clay in a cultivated field in Blanchard Township, NW¼NW¼ sec. 19, T. 1 N., R. 8 E., Laboratory No. PT-27:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay; strong, fine and medium, subangular blocky structure; firm; neutral; abrupt, smooth boundary.
B21g—8 to 16 inches, dark-gray (10YR 4/1) silty clay; few, fine, prominent, yellowish-red (5YR 4/6) mottles and few, medium, distinct, yellowish-brown (10YR 5/8) mottles; strong, fine, subangular blocky structure; firm; neutral; clear, wavy boundary.
B22g—16 to 26 inches, gray (10YR 5/1) silty clay; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; strong, medium and coarse, subangular blocky structure; very firm; neutral; gradual, wavy boundary.
B23g—26 to 39 inches, gray (10YR 6/1) silty clay; many, medium and coarse, prominent, brownish-yellow (10YR 6/8) mottles; strong, coarse, subangular blocky structure parting to moderate, medium and fine, subangular blocky; very firm; mildly alkaline; gradual, wavy boundary.
B3g—39 to 55 inches, gray (10YR 6/1) silty clay; many, medium and coarse, prominent, strong-brown (7.5YR 5/6) mottles; moderate, coarse, subangular blocky structure parting to weak, fine and medium, subangular blocky; very firm; mildly alkaline; clear, wavy boundary.
Cg—55 to 80 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, distinct, gray (10YR 6/1) mottles; massive; extremely firm; moderately alkaline, calcareous.

The solum ranges from 30 to 55 inches in thickness. This commonly coincides with the depth to carbonates, but in places the lower few inches of the solum are calcareous. The upper part of the solum is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

The Ap horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is silty clay or silty clay loam. The B2 horizon has a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. The mottles have a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 4, 6, or 8. Texture is silty clay or clay. The C horizon has a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 4 or 6. Mottles have a hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. The C horizon is dominantly silty clay loam or silty clay, but in places it has thin lenses of silt loam, silt, or fine sand.

Toledo soils are the very poorly drained members of a drainage sequence that includes the moderately well drained Lucas soils, the somewhat poorly drained Fulton soils, and the dark-colored and very poorly drained Bono soils. Toledo soils differ from Hoytville soils in having a lower content of sand and coarse fragments. They differ from Lenawee soils in having a higher content of clay throughout the profile. Toledo soils have less clay in the B horizon than Paulding soils.

Toledo silty clay loam (To).—This nearly level soil commonly is on the slightly depressional flats of the lake plain in the central part of the county. Many areas of it are adjacent to Fulton and Lucas soils. This soil has a profile similar to the one described as representative for the series, but the surface layer has less clay. This soil thus is more easily cultivated than Toledo silty clay, and it is less cloddy.

Included with this soil in mapping were areas of soils that have a silt loam surface layer. Also included were a few spots of finer textured Paulding soils and a few spots of coarser textured Lenawee soils.

Seasonal wetness is a severe limitation if this soil is farmed. Slow permeability and seasonal wetness are limitations to many nonfarm uses. Capability unit IIIw-2.

Toledo silty clay (Tt).—This nearly level soil is mainly in northern Monroe Township and in the upper watershed of North and South Powell Creeks in Palmer Township. It commonly is adjacent to Fulton and Paulding soils. The areas of this soil generally are broad and long. A profile of this soil is described as representative for the series.

Included with this soil in mapping were spots of light-colored, somewhat better drained Fulton soils and spots of finer textured Paulding soils.

Seasonal wetness is a severe limitation if this Toledo soil is farmed. Slow permeability and seasonal wetness are limitations to many nonfarm uses. Capability unit IIIw-2.

Tuscola Series

The Tuscola series consists of gently sloping soils that are moderately well drained. These soils formed in loamy materials that are high in content of silt and fine sand and are underlain by stratified silt and fine sand. They are on rises of the lake plain and on the moraine in the east-central part of the county.

In a representative profile of a Tuscola soil that is cultivated, the plow layer is dark grayish-brown loam 8 inches thick. The subsoil is 30 inches thick. It is dark yellowish-brown loam in the uppermost 6 inches; the next layer is 10 inches of yellowish-brown light silty clay loam mottled with brown; below this is 8 inches of brown light silty clay loam mottled with grayish brown; and the lowermost layer is 6 inches of grayish-brown fine sandy loam mottled with yellowish brown. The substratum begins at a depth of 38 inches and extends to a depth of more than 60 inches. It is gray silt loam mottled with yellowish brown.

Runoff is slow to moderate on Tuscola soils, and permeability is moderate. These soils are saturated with water for short periods in winter and in spring. They have a high available water capacity. The root zone is deep. It is mostly medium acid to neutral.

Tuscola soils are used mainly for corn, soybeans, and small grain.

Representative profile of Tuscola loam, 2 to 6 percent slopes, in a cultivated field in Blanchard Township, NE¼SW¼ sec. 7, T. 1 N., R. 8 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, granular structure; very friable; medium acid; abrupt, smooth boundary.

B1t—8 to 14 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine and medium, subangular blocky structure; friable; few, thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical faces of peds; slightly acid; clear, wavy boundary.

B21t—14 to 24 inches, yellowish-brown (10YR 5/4) light silty clay loam; few, fine, faint, brown (10YR 5/3) mottles; weak, medium, subangular blocky structure; firm; few, thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical and horizontal ped faces; slightly acid; diffuse, wavy boundary.

B22t—24 to 32 inches, brown (10YR 5/3) light silty clay loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; few, thin, patchy, brown (10YR 4/3) clay films on vertical faces of peds; neutral; abrupt, wavy boundary.

B3—32 to 38 inches, grayish-brown (10YR 5/2) fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; mildly alkaline, calcareous; diffuse, wavy boundary.

C—38 to 60 inches, gray (10YR 5/1) silt loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; moderately alkaline, calcareous; lacustrine sediment.

The solum ranges from 30 to 44 inches in thickness. This commonly coincides with the depth to carbonates, although in some places the B3 horizon is calcareous. The upper part of the B horizon is medium acid or slightly acid, and the lower part is neutral or mildly alkaline. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The B1 and B2 horizons have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Texture ranges from fine sandy loam to light silty clay loam. The B3 and C horizons are 10YR in hue, 4 or 5 in value, and 1 or 2 in chroma. They are typically stratified with layers of fine sandy loam, loam and silt loam. Thickness of these layers ranges from one-eighth inch to several inches.

Tuscola soils are the moderately well drained members of a drainage sequence that includes the somewhat poorly drained Kibbie soils and the very poorly drained Colwood soils. Tuscola soils have a coarser textured B horizon and a less clayey solum than the moderately well drained Lucas or Shinrock soils. Unlike the Rawson soils, Tuscola soils do not have a contrasting, finer textured horizon within a depth of 40 inches.

Tuscola loam, 2 to 6 percent slopes (TuB).—This soil is mostly on the moraine in the east-central part of the county. Generally, its areas are long and narrow and are adjacent to areas of Ottokee, Fulton, Del Rey, and Kibbie soils. A profile of this soil is described as representative for the series.

Included in mapping were areas where the surface layer is fine sandy loam, spots of steeper Tuscola soils, and spots of finer textured Shinrock soils.

A moderate erosion hazard is the main limitation to use of this soil for farming. Slope is a limitation to some nonfarm uses. Capability unit IIe-1.

Tuscola-Shinrock complex, 2 to 6 percent slopes (TwB).—This complex is on the moraine in the east-central part of the county. The complex is about 40 percent Tuscola soils and 40 percent Shinrock soils. The remaining 20 percent is Ottokee, Rawson, and Haney soils. A moderate erosion hazard is the major limitation to use of these soils for farming. Slope is a limitation to some nonfarm uses. Capability unit IIe-1.

Urban Land

Urban land (Ur) consists of industrial areas and areas within cities and towns. Most areas of this land type are covered with buildings, streets, or parking lots. The original soil in areas of Urban land has been disturbed or altered to the extent that no recognizable soil profile remains. Runoff from surfaced areas of Urban land is very rapid. Not placed in a capability unit.

Vaughnsville Series

The Vaughnsville series consists of gently sloping soils that are moderately well drained. These soils formed in loamy material underlain by calcareous glacial till. They occur on the inner (or lake) slope of the beach ridges.

The reddish color of Vaughnsville soils is a distinctive feature where these soils are plowed.

In a representative profile of a Vaughnsville soil that is cultivated, the plow layer is dark-red loam 8 inches thick. The subsoil is 30 inches thick. The uppermost layer is 8 inches of dark reddish-brown sandy clay loam; the next layer is 3 inches of red clay loam mottled with dark brown; next is 11 inches of reddish-brown clay loam mottled with dark brown; below this is 8 inches of reddish-brown sandy loam mottled with reddish gray; and the lowermost layer is reddish-brown sandy loam mottled with reddish gray. The substratum, which begins at a depth of 38 inches and extends to a depth of 60 inches or more, is dark yellowish-brown clay loam mottled with gray.

Vaughnsville soils have moderate permeability in the subsoil and slow permeability in the underlying finer textured material. Runoff is slow to moderate. These soils have medium available water capacity. The root zone is moderately deep. It is neutral to slightly acid.

Vaughnsville soils are used primarily for corn, soybeans, and small grain.

Representative profile of Vaughnsville loam, 2 to 6 percent slopes, in a cultivated field in Sugar Creek Township, SW¼SE¼ sec. 1, T. 2 S., R. 6 E.:

Ap—0 to 8 inches, dark-red (2.5YR 3/6) loam; moderate, fine and medium, granular structure; friable; 2 percent pebbles; slightly acid; abrupt, smooth boundary.

B1t—8 to 16 inches, dark reddish-brown (2.5YR 3/4) sandy clay loam; moderate, fine and medium, subangular blocky structure; friable; few, thin, patchy, dark-brown (7.5YR 4/2) clay films on vertical ped faces; 2 percent pebbles; slightly acid; abrupt, wavy boundary.

B21t—16 to 19 inches, red (2.5YR 4/6) clay loam; many, medium, distinct, dark-brown (7.5YR 4/2) mottles; moderate, fine and medium, subangular blocky structure; firm; few, thin, patchy, brown (7.5YR 4/4) clay films on vertical and horizontal ped faces; 2 percent pebbles; neutral; clear irregular boundary.

B22t—19 to 30 inches, reddish-brown (5YR 4/4) clay loam; many, medium, distinct, dark-brown (7.5YR 4/2) mottles; strong, fine and medium, subangular blocky structure; firm; few, thin, patchy, brown (7.5YR 4/4) clay films on vertical and horizontal ped faces; 2 percent pebbles; neutral; clear, irregular boundary.

B23—30 to 38 inches, reddish-brown (5YR 4/3) sandy loam; many, medium, distinct, reddish-gray (5YR 5/2) mottles; weak, fine and medium, subangular blocky structure; very friable; 10 percent pebbles; neutral; abrupt, wavy boundary.

IIC—38 to 60 inches, dark yellowish-brown (10YR 4/4) clay loam; many, medium, distinct, gray (10YR 6/1) mottles; massive; extremely firm; 2 percent fragments of black shale, chert, and igneous material; mildly alkaline, calcareous glacial till.

The solum ranges from 30 to 40 inches in thickness, but most commonly it is about 35 inches thick. This commonly coincides with the depth to carbonates, but in places the bottom few inches of the solum is weakly calcareous. Reaction in the upper part of the solum is slightly acid to neutral, and in the lower part it is neutral to mildly alkaline. The Ap horizon has a hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 4 or 6. The B horizon has a hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 3, 4, or 6. The mottles in the B2 horizon have a hue of 10YR, 7.5YR or 5YR, value of 4, 5, or 6, and chroma of 2. The B horizon texture ranges from clay loam to gravelly sandy loam. The IIC horizon has a hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4, 6, or 8. The texture ranges from clay loam to clay.

Vaughnsville soils are commonly adjacent to the moderately well drained Rawson and Haney soils and the somewhat poorly drained Digby and Haskins soils. Vaughnsville soils differ from those soils in having redder hues in the A horizon and the upper part of the B horizon. This reddish color probably resulted from the precipitation of iron oxides from seepage waters.

Vaughnsville loam, 2 to 6 percent slopes (VoB).—This soil is on the flanks of beach ridges, generally on the lakeside slopes. The areas of this soil commonly are long and narrow.

Included with this soil in mapping were spots of Belmore, Rawson, and Haney soils. None of these included soils have reddish colors.

Seasonal wetness is a moderate limitation to use of this soil for farming. Seasonal wetness is also a limitation to many nonfarm uses. Capability unit IIw-2.

Wabasha Series

The Wabasha series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in stratified, clayey recent alluvium on flood plains that are adjacent to sluggish streams that flow through the lake plain.

In a representative profile of a Wabasha soil that is cultivated, the plow layer is very dark gray silty clay 6 inches thick. The subsoil is 42 inches thick. In the upper 12 inches, it is dark grayish-brown clay mottled with dark yellowish brown; the middle part is 13 inches of olive-gray mottled with yellowish brown; and the lower part is 17 inches of dark yellowish-brown clay mottled with olive gray. The substratum begins at a depth of 48 inches and extends to a depth of 60 inches or more. It consists of dark-gray, stratified clay, silty clay, and heavy silty clay loam mottled with yellowish brown.

Runoff on Wabasha soils is slow, and permeability is slow. Available water capacity is medium to high. The water table is seasonally high for long periods. In summer, when the water table is low, the root zone is deep. The root zone is neutral or mildly alkaline.

Wabasha soils are used mostly for corn and soybeans. Susceptibility to flooding in winter and in spring commonly prevents the growing of small grain. Tilth is a concern at times because of the clayey surface layer. This condition is reduced if Wabasha soils are cultivated when they are not too wet.

Representative profile of Wabasha silty clay in a cultivated field in Monterey Township, NW¼NE¼ sec. 1, T. 1 S., R. 4 E.:

Ap—0 to 6 inches, very dark gray (10YR 3/1) silty clay; strong, fine and medium, subangular blocky structure; firm; neutral; abrupt, smooth boundary.

B21g—6 to 18 inches, dark grayish-brown (2.5Y 4/2) clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, prismatic structure parting to moderate, fine, subangular blocky; very firm; very dark gray (10YR 3/1) coatings on ped faces; neutral; gradual, wavy boundary.

B22g—18 to 31 inches, olive-gray (5Y 5/2) clay; many, medium, prominent, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; very firm; neutral; gray (5Y 5/1) coatings on ped faces; gradual, wavy boundary.

B23g—31 to 48 inches, dark yellowish-brown (10YR 4/4) clay; common, medium, prominent, olive-gray (5Y 5/2) mottles; weak, coarse, subangular blocky structure; very firm; dark-gray (5Y 4/1) coatings on ped faces; mildly alkaline; clear, wavy boundary.

Cg—48 to 60 inches, dark-gray (10YR 4/1) stratified clay, silty clay, and heavy silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; firm; stratified alluvium that has a few thin lenses of clay loam, loam, or sandy loam; mildly alkaline.

The solum ranges from 40 to 60 inches in thickness. This commonly coincides with the depth to carbonates, but in places the lower part of the solum is calcareous. The Ap horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B2 horizon has a hue of 10YR, 5Y, or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Mottles have a hue of 10 YR, 5Y, or 2.5Y, value of 4 or 5, and chroma of 4 to 6. In some places the color of the matrix and color of mottles are reversed in the lower part of the B2 horizon. Texture is clay or silty clay. The C horizon has a hue of 10YR, value of 4 or 5, and chroma of 1 or 2. Mottles have a hue of 10YR, value of 4 or 5, and chroma of 4 to 8.

Wabasha soils are the very poorly drained members of a drainage sequence that includes the somewhat poorly drained Defiance soils. Wabasha soils are more clayey throughout than the very poorly drained Sloan soils.

Wabasha silty clay (Wa).—This nearly level soil is on low-lying flood plains along the more sluggish streams. It is near areas of Defiance soils and in places near areas of Sloan soils. In addition to improving drainage and controlling flooding, maintaining good tilth is difficult because of the fine-textured surface layer.

Included with this soil in mapping were areas of soils that have a silty clay loam surface layer and a few spots of the coarser textured Sloan soils.

Susceptibility to flooding and wetness are the main limitations to both farm and nonfarm uses of this Wabasha soil. Capability unit IIIw-3.

Wabasha Series, Moderately Shallow Variant

The Wabasha series, moderately shallow variant, consists of nearly level, dark-colored, very poorly drained soils that formed in clayey alluvium underlain by limestone bedrock at a depth of 20 to 40 inches. These soils are on the flood plain of Jennings Creek in the southern part of Monterey Township.

In a representative profile of Wabasha soils, moderately shallow variant, the plow layer is very dark gray silty clay loam 8 inches thick. The subsoil, which extends from a depth of 8 inches to a depth of 30 inches, is dark-gray silty clay mottled with yellowish brown. The subsoil rests on limestone bedrock.

Runoff and permeability are slow. These soils have medium available water capacity, and the water table is seasonally high for long periods. The root zone is moderately deep, and it is neutral or mildly alkaline.

These soils are used primarily for corn and soybeans.

Representative profile of Wabasha silty clay loam, moderately shallow variant, in a cultivated field in Monterey Township, SW¼SE¼ sec. 35, T. 1 S., R. 4 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam; strong, fine and medium, subangular blocky structure; firm; neutral; abrupt, smooth boundary.

B21g—8 to 15 inches, dark-gray (10YR 4/1) silty clay; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; strong, medium, subangular blocky structure; very firm; neutral; clear, irregular boundary.

B22g—15 to 30 inches, dark-gray (10YR 4/1) silty clay; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; very firm; few thin lenses of sandier material; neutral; clear, wavy boundary.

R—30 inches, limestone bedrock.

The depth to limestone bedrock ranges from 20 to 40 inches. Reaction in the upper part of the solum is neutral, and in the lower part it is neutral or mildly alkaline. The Ap horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B2 horizon has a hue of 10YR, 5Y, or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Mottles have a hue of 10YR, 5Y, or 2.5Y, value of 4 or 5, and chroma of 4 to 6. The texture is silty clay or clay.

Wabasha soils, moderately shallow variant, are near the somewhat poorly drained, deep Defiance soils on the flood plain.

Wabasha silty clay loam, moderately shallow variant (Wb).—This nearly level soil is on the flood plain of Jennings Creek in the southwestern part of the county near the Van Wert County line.

Susceptibility to flooding and wetness are the main limitations to both farm and nonfarm uses of this soil. The moderate depth to limestone bedrock severely restricts the installation of drain tile because the necessary depth and grade are difficult to obtain. Capability unit IIIw-3.

Wauseon Series

The Wauseon series consists of nearly level, dark-colored soils that are very poorly drained. These soils formed in sandy material that is underlain by finer textured lacustrine clay. They occur in slight depressions adjacent to better drained sandy soils on uplands.

In a representative profile of a Wauseon soil that is cultivated, the surface layer is very dark gray fine sandy loam 9 inches thick. The subsurface layer is 5 inches of very dark grayish-brown fine sandy loam. The subsoil is 22 inches thick. In the upper 6 inches, it is dark grayish-brown fine sandy loam mottled with yellowish brown, and in the lower 16 inches, it is light brownish-gray fine sandy loam mottled with yellowish brown. The substratum, which begins at a depth of 36 inches and extends to a depth of 60 inches or more, is light-gray clay mottled with dark yellowish brown and yellowish brown.

Runoff is very slow on Wauseon soils. Permeability is rapid in the sandy material and very slow in the underlying clayey material. Available water capacity is medium. If these soils are artificially drained, the root zone is deep; otherwise, it is deep only in summer, when the water table is low. The root zone is slightly acid to neutral in the upper part.

Wauseon soils are used for cultivated crops. Most of the acreage has been artificially drained for improved plant growth and more timely tillage.

Representative profile of Wauseon fine sandy loam, in a cultivated field in Perry Township, SE¼NW¼ sec. 9, T. 1 N., R. 5 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) fine sandy loam; weak and moderate, fine and medium, granular structure; very friable; neutral; abrupt, smooth boundary.

A12—9 to 14 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, fine, subangular blocky structure; very friable; neutral; gradual, wavy boundary.

B21g—14 to 20 inches, dark grayish-brown (10YR 4/2) fine sandy loam; many, fine and medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; very weak, fine, subangular blocky structure; very friable; neutral; gradual, wavy boundary.

B22g—20 to 36 inches, light brownish-gray (10YR 6/2) fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; very weak, fine, subangular blocky structure; very friable; neutral; abrupt, wavy boundary.

IIC—36 to 60 inches, light-gray (10YR 6/1) clay; common, medium and coarse, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; massive; extremely firm; mildly alkaline, calcareous, compact lacustrine sediment.

The thickness of the solum and the depth to the fine-textured material in the IIC horizon range from 24 to 36 inches but commonly are about 35 inches. This commonly coincides with the depth to carbonates, but in places the lower part of the B2 horizon, or the B3 horizon where present, is calcareous. The dark-colored A horizon is more than 10 inches in thickness and generally ranges from 13 to 16 inches. The A horizon has a hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B2 horizon has a hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 or 2. Mottles have a hue of 10YR, 5Y, or 2.5Y, value of 4 or 5, and chroma is 4 to 6. The IIC horizon has a hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The texture is clay or silty clay.

Wauseon soils are the very poorly drained members of a drainage sequence that includes the moderately well drained Seward soils and the somewhat poorly drained Rimer soils. Wauseon soils have a lower content of clay in the B horizon than the similar Mermill soils.

Wauseon fine sandy loam (Wf).—This nearly level soil generally is in depressions adjacent to better drained, sandy soils near the village of Dupont. The areas of this soil are irregular in shape and in most places are surrounded by areas of soils that occupy higher pastures.

Included with this soil in mapping were spots of the finer textured Mermill soils and a few spots of the better drained Rimer soils. Also included were a few spots of soils where the depth to the underlying fine-textured material is either slightly less or slightly greater than the range defined for this soil.

Very poor natural drainage and seasonal wetness are moderate limitations to use of this soil for farming. They are also limitations to most nonfarm uses. Capability unit IIw-5.

Willette Series

The Willette series consists of black organic soils that are very poorly drained and are underlain by lacustrine clay at a depth of 16 to 42 inches. These soils are in Palmer Township in the upper watershed of South Powell Creek. The original vegetation was reeds, sedges, and water-tolerant grasses.

In a representative profile of a Willette soil, the uppermost layer is 18 inches of black, acid, very friable muck. The next layer is 7 inches of dark reddish-brown, acid, very friable muck. Underlying these layers of muck at a depth of 25 inches is calcareous, very firm lacustrine clay that extends to a depth of 60 inches or more.

Willette soils have a high water table for long periods unless they are drained. They have slow permeability in the underlying clayey material. The root zone is moderately deep if these soils are artificially drained. They have medium to high available water capacity. The organic part of this soil is medium acid to slightly acid.

These soils are used mostly for corn and soybeans.

Representative profile of Willette muck, in a cultivated field in Palmer Township, NW¼NE¼ sec. 34, T. 2 N., R. 6 E.:

Oa1—0 to 9 inches, black (N 2/0) muck (sapric material); few, small, woody fragments; moderate, fine, granular structure; very friable; slightly acid; diffuse, wavy boundary.

Oa2—9 to 18 inches, black (N 2/0) muck (sapric material); few, small, woody fragments; weak, medium, granular structure; very friable; slightly acid; gradual, wavy boundary.

Oa3—18 to 25 inches, dark reddish-brown (5YR 2/2) muck (sapric material); weak, medium, granular structure; very friable; slightly acid; abrupt, wavy boundary.

IIC—25 to 60 inches, light-gray (10YR 6/1) clay that has many, medium, distinct, yellowish-brown (10YR 5/4) mottles and few, fine, prominent, dark reddish-brown (5YR 3/4) mottles; massive; very firm; moderately alkaline; calcareous lacustrine sediment.

The depth to the IIC horizon ranges from 16 to 42 inches, but it is generally about 30 inches. Reaction in the O horizon ranges from medium acid to neutral. The reaction in the underlying IIC horizon is mildly alkaline or moderately alkaline. The IIC horizon has a hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The mottles have a hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 4 to 8.

Willette soils commonly are near Toledo and Paulding soils. They are the only organic soils in Putnam County.

Willette muck (Wm).—This nearly level soil occurs on broad flats in oval areas.

Included with this soil in mapping in a few areas are spots where the organic material is less than 16 inches thick. Also included are a few spots of the very poorly drained Toledo soils, which do not have an organic surface layer.

A high water table is the major limitation to use of this soil for crops. The high water table and instability are limitations to most nonfarm uses. Capability unit IIIw-4.

Formation and Classification of Soils

This section lists the factors and processes of soil formation and discusses the effects they have had on the formation of soils in Putnam County. It also explains the system of soil classification and places the soil series in categories of that system. The soil series in this county, including a representative profile for each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soils are the products of soil-forming processes that act on materials deposited or accumulated by geologic forces. The important factors in soil formation are parent material, climate, living organisms, relief, and time.

Climate and living organisms, particularly vegetation, are the active forces in soil formation. Their effect on the parent material is modified by relief and by the length of time other factors of soil formation have acted on the parent material. The relative importance of each factor differs from place to place. In a few 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 that forms in any given place.

The differences among the soils in this county resulted chiefly from the influence of parent material and relief.

Climate and vegetation have strongly influenced the development of the soils, but those factors are nearly uniform throughout the county.

All of the county was covered by glaciers, most recently by the Wisconsin Glaciation. The soils formed since this glacial retreat. The interval of time since the retreat of the glacier probably has been short enough so that differences in time have not had any marked effect that accounts for variations among the soils. The parent material and relief, therefore, are the major factors that account for the differences among soils in the county.

Parent material

Glacial till and lacustrine deposits are the main kinds of parent material from which the soils in Putnam County formed (*5*). The Wisconsin glaciers covered the area many centuries ago and left a mantle of fine-textured till. For an extended period the glacier was stationary near the northern part of Ohio, and large glacial lakes formed. During this time lacustrine sediment was deposited over much of the county.

In Putnam County lacustrine materials and glacial till are dominant, but they have been altered to varying degrees by lake waters. The only part of the county that appears to have been relatively free of the influence of the glacial lakes is the glacial till plain south of State Route No. 12 in the southeastern part of the county.

The soils in about one-third of the county were derived mainly from fine-textured, calcareous glacial till. The clay content of the till ranges from 38 to 48 percent. The wave action of the glacial lakes that covered this area probably reworked and modified the till considerably. The Hoytville and Nappanee soils are dominant in areas that make up much of the southern part of the county and a large area in the northeastern part.

About one-quarter of the county is made up of lacustrine clays that are essentially free of glacial material. The material has a clay content of 60 to 80 percent and a calcium carbonate equivalent of 15 to 25 percent. The Paulding and Roselms soils are dominant in this area, which occupies much of the central, west-central, and northwestern parts of the county.

Other lacustrine areas that show very little evidence of glacial material are in the central part and the extreme northwestern corner of the county. The soils in these areas formed in lacustrine clay and silt that have a clay content of 40 to 60 percent. Toledo and Fulton soils are dominant in these areas.

The Defiance Moraine has a distinctly different relief from that of most of Putnam County. This moraine occurs in the northern half of Blanchard Township, the extreme southwestern part of Van Buren Township, the southeastern part of Liberty Township, and the extreme northeastern part of Ottawa Township. It is made up of various parent materials, most of which are of lacustrine origin and generally overlie glacial till. The Kibbie, Del Rey, Fulton, and Toledo soils are dominant in this area.

Climate

The climate throughout Putnam County is uniform enough that differences in climate generally have not greatly contributed to differences among the soils.

The climate of Putnam County has been favorable to both physical change and chemical weathering of parent material and to biological activity.

Rainfall has been such that there was adequate percolating water to leach carbonates to moderate depths, as in the Morley and Blount soils. Frequency of rainfall has allowed wetting and drying that are favorable to the translocation of clay minerals and the formation of soil structure, as in the Morley and Hoytville soils.

Temperature variations have been in a range that favored both physical change and chemical weathering of parent material. Freezing and thawing have aided in the development of soil structure. Warm summer temperatures have favored chemical reaction in the weathering of primary mineral.

Both rainfall and temperature were conducive to plant growth and subsequent accumulation of organic matter in all the soils.

Vegetation

The original vegetation of Putnam County was primarily deciduous swamp forest (*8*). The trees common on the very poorly drained and somewhat poorly drained soils were black ash, white ash, American elm, shagbark hickory, basswood, swamp white oak, bur oak, pin oak, sycamore, silver maple, and cottonwood. Scattered throughout the swamp forest were a few areas of better drained soils on sandy or gravelly beach ridges and knolls and in areas of sloping soils, such as those bordering streams, where black oak, beech, hard maple, and black cherry were dominant.

Relief

Most of Putnam County is within the glacial lake plain of the northwestern part of Ohio. Exceptions are the gently sloping Defiance Moraine in the east-central part of the county and the nearly level to gently sloping Ft. Wayne ground moraine in the southeastern part, south of State Route No. 12. Consequently, most of the land surface consists of a nearly flat plain where runoff of surface water is slow. In places this relief is interrupted by sandy ridges or knolls, and by sides of valleys associated with streams that are sluggish and have a low gradient. The sandy and gravelly ridges represent the beaches, dunes, and offshore bars of the various stages of the glacial lakes that existed in Putnam County.

Most of the soils on the lake plain and the Ft. Wayne ground moraine are very poorly drained. The soils on ridges, knolls, and valley slopes are well drained to somewhat poorly drained.

Time

Time is needed for the other soil-forming factors to produce their effect. To some extent the age of a soil is indicated by the degree of development of its profile. In many places, however, factors other than time have been responsible for most of the differences in kind and distinctness of horizons in the different soils. If the parent material weathers slowly, the profile develops slowly. If slopes are steep, and the soil is removed almost as fast as it is formed, distinct horizons are not developed.

The age of the lake plain areas of Putnam County is believed to be about 10,000 to 13,000 years (*4*). The small area of glacial till plain in the southeastern part of the county may be as old as 15,000 years. The soils of Putnam County have been developing a relatively short time, compared with soils of other areas that formed in material from earlier glaciation or in unglaciated areas. This short time for development partly accounts for the shallow depth of leaching and also for the less acid reaction of some of the soils in the county.

Processes of Soil Formation

The factors of soil formation largely control or influences four soil-forming processes. These processes are additions, losses, transfers, and alterations (*9*). Some of the processes promote differences within a soil; others retard or preclude differences. The differentiation of horizons in soils in Putnam County is the result of one or more of the above processes. These processes have taken place, or are beginning to take place, but the degree of expression of each process varies from soil to soil.

The most obvious addition is the accumulation of organic matter in the surface layer of the soils. Others are addition of bases in organic matter and in ground water, addition of bases contained in lime and fertilizer, and deposition of eroded material.

The dark-colored surface layer in the Hoytville, Toledo, Millgrove, and Mermill soils illustrates addition of organic matter. All the soils in the county have some accumulation of organic matter, but on the soils where organic matter was originally thin, plowing and cultivating have largely destroyed the organic matter or has incorporated it with other horizons. The Nappanee, St. Clair, Fulton, and Lucas soils show limited addition of organic matter. The Digby, Haskins, Rimer, and Tedrow soils have a somewhat higher content of organic matter than other similar soils. Plant nutrients are recycled from soil to plant and back to the soil again in the form of litter or organic matter. This process occurs in all the soils.

Soils that are seasonally waterlogged, such as the Hoytville, Toledo, Millgrove, and Colwood, continually accumulate bases through addition from the ground water. The additions of bases generally are greater than the losses on these soils.

Soils such as the Genesee, Sloan, Wabasha, and Shoals periodically receive additions of soil material that is deposited during flooding. The application of lime and fertilizer on cropland and pasture areas counteracts plant nutrient losses that normally occur. Where heavy liming and fertilization is used, nutrient gains are likely to exceed nutrient losses.

Soil losses result from the removal of bases by leaching, removal of plant nutrients by crops, actual losses of soil material by erosion, and losses through volatilization. One of the most significant losses of the soils in Putnam County is the removal of carbonates by leaching. Most finer textured, light-colored soils on uplands have the carbonates removed to a depth of 2 to 3 feet. This is a considerable loss of carbonates because the glacial till or lacustrine clays range from 15 to 25 percent calcium carbonate before weathering. The coarser textured soils generally are leached to a greater depth that ranges from 3 to 8 feet. Some of these are the Ottokee, Belmore, and Arkport soils. Carbonate loss precedes other chemical changes in the solum, and the total removal is slower in those soil materials that have a high content of carbonate.

Other minerals are subject to the same chemical weathering and are also lost by leaching, but at slower rates. Alteration of other minerals produces iron oxides. These oxides are leached from soils on the beach ridges and precipitated and concentrated in a strip along the base of the beach ridge by percolating ground water. This causes the characteristic reddish color of the Vaughnsville soils. The presence of ferric oxides in the soil makes mottles and colors brighter.

The most significant transfers in the soils of Putnam County involve transfers of colloidal material from the surface layer to layers below. The primary minerals are transformed largely to silicate clay minerals by the processes of hydrolysis and base substitution. Most of the clay remains in the soil profile, but much of the fine clay is transferred from the A horizon to a greater depth in the profile. It is carried downward by percolating water. Seasonal drying or precipitation causes the fine clays to be deposited as clay films on the surface of soil peds and in cracks and in root and earthworm channels. Clay films are observable in the Del Rey, Haskins, Nappanee, Fulton, and other similar soils. Illite (hydrous mica) is dominant in the clay fraction of 18 of the soils in Putnam County. In 21 of the soils, the clays are mixed and no one clay mineral is dominant. The mixed clays contain illite, montmorillonite, vermiculite, and some kaolinite. Kaolinite clay, however, is a product of fairly intense weathering. Since the soils in Putnam County have not been so weathered, only minor amounts of this clay occur in the soils. The translocation and development in place of these silicate clay minerals has had a strong influence on the development of horizons in about one-half of the soils in Putnam County.

Various sesquioxides have also been transferred from the surface layer to lower layers by this weathering process. The reduction and solution of iron has taken place in the very poorly drained and somewhat poorly drained soils. This reduction of iron, called gleying, is evident in the Hoytville, Toledo, Millgrove, Colwood, and other similar soils because they have a recurring water table. Gray colors indicate a soil condition favorable to reduction. Reduced iron is soluble, but in Putnam County it commonly has been moved only a short distance. It stops in the horizon where it originated or in an underlying one. Part of this iron may be reoxidized and segregated to form the commonly observed bright-colored yellow and red mottles. Mottling observed in all except well-drained soils is caused by this alteration of iron in the soil, which results from a fluctuating water table. Accumulations of iron and manganese are common in somewhat poorly drained and very poorly drained soils. These accumulations occur as dark-brown or black blotches on ped surfaces or as small shotlike concretions.

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 behavior 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 to 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.

The classification system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. This system is under continual study. Readers interested in developments of the system should study the latest literature available (*12*).

Under the system of classification, six categories are recognized. Beginning with the broadest and the most inclusive, these categories 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 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 are shown in table 8. The suborder and great group are not shown separately as they are formative elements in the naming of the subgroups.

ORDERS.—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. Five soil orders are represented in Putnam County. They are Entisols, Inceptisols, Mollisols, Alfisols and Histosols.

Entisols are mineral soils either without natural genetic horizons or with only the beginning of such horizons.

Inceptisols are mineral soils in which horizons have started to develop but which do not have an accumulation of illuvial clay in the B horizon.

Mollisols are mineral soils that have a dark-colored surface layer, 10 inches or more thick, that has a base saturation of more than 50 percent.

Alfisols are mineral soils that have a B horizon of clay accumulation and a base saturation of more than 35 percent within a depth of 50 inches from the top of the Bt horizon.

Histosols are organic soils.

SUBORDERS.—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 GROUPS.—Suborders are separated into groups according to the presence or absence of genetic horizons and the arrangements of these horizons. The horizons used to make separations are those in which clay, iron, or humus have accumulated, or those that have pans that interfere with the growth of roots or the movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

SUBGROUPS.—Great groups are divided into subgroups, one that represents the central, or typic, segment of a group, and others, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. Examples are Aquic, Arenic, Hapludalfs, and Typic Haplaquolls.

FAMILIES.—Families are separated within a subgroup on the basis of properties important to the growth of plants or to the behavior of soils if used for engineering. Among the properties considered are texture, reaction, soil temperature, mineralogy, thickness of horizons, and consistence.

SERIES.—The series has the narrowest range of characteristics of the categories in the classification system. It is defined in the section "How This Survey Was Made." A detailed description of each soil series in the county is given in the section "Descriptions of the Soils."

Some of the soils in this county do not fit in a series that has been recognized in the classification system, but recognition of a separate series would not serve a useful purpose. Such soils are named for the series they strongly resemble because they differ from those series in ways too small to be of consequence in interpreting their usefulness or behavior. Soil scientists designate such soils taxadjuncts to the series for which they are named. In this survey, soils named in the Blount, Genesee, Kibbie, Lenawee, St. Clair, and Tedrow series are taxadjuncts to those series.

Laboratory Data

Laboratory data are given for seven soil series in Putnam County in table 9. Profile descriptions for soils in the Fulton, Hoytville, Nappanee, and Toledo series are given in the section "Descriptions of the Soils". Descriptions of soils in the Del Rey, Paulding, and Roselms series are in this section. The Del Rey soils (PT–35) have a somewhat higher content of sand in the subsoil than is typical in the county. The Paulding soils (PT–19) have a surface layer of silty clay rather than clay or silty clay loam, as is typical in the county. The Roselms soils (PT–20) have a surface layer of clay, rather than silty clay loam or silt loam, as also is typical in the county. Data given in table 9 were obtained by laboratory analyses at the Agronomy Department, OARDC, Columbus, Ohio.

The following paragraphs outline some of the procedures used to obtain the data presented in table 9.

TABLE 8.—*Soil series classified according to the current system*

Series	Family	Subgroup	Order
Arkport	Coarse-loamy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Belmore	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Blount [1]	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Bono	Fine, illitic, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Broughton	Very fine, illitic, mesic	Aquic Hapludalfs	Alfisols.
Colwood	Fine-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Defiance	Fine, illitic, nonacid, mesic	Aeric Fluvaquents	Entisols.
Del Rey	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Digby	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Fulton	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Genesee [1]	Fine-loamy, mixed, nonacid, mesic	Fluventic Eutrochrepts	Inceptisols.
Haney	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Haskins	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Hoytville	Fine, illitic, mesic	Mollic Ochraqualfs	Alfisols.
Kibbie [1]	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Latty	Fine, illitic, nonacid, mesic	Typic Haplaquepts	Inceptisols.
Lenawee [1]	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Lucas	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Mermill	Fine-loamy, mixed, mesic	Mollic Ochraqualfs	Alfisols.
Millgrove	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Morley	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Nappanee	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Ottokee	Mixed, mesic	Alfic Udipsamments	Entisols.
Paulding	Very fine, illitic, nonacid, mesic	Typic Haplaquepts	Inceptisols.
Pewamo	Fine, mixed, mesic	Typic Argiaquolls	Mollisols.
Rawson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Rimer	Loamy, mixed, mesic	Aquic Arenic Hapludalfs	Alfisols.
Roselms	Very fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
St. Clair [1]	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Seward	Loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Shinrock	Fine, illitic, mesic	Aquic Hapludalfs	Alfisols.
Shoals	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Sloan	Fine-loamy, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Tedrow [1]	Mixed, mesic	Aquic Udipsamments	Entisols.
Toledo	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Tuscola	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Vaughnsville	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Wabasha	Fine, illitic, nonacid, mesic	Mollic Fluvaquents	Entisols.
Wauseon	Coarse-loamy over clayey, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Willette	Clayey, euic, mesic	Terric Medisaprists	Histosols.

[1] These soils are taxadjuncts to the named series in Putnam County. For a discussion of how these soils differ from the series, read the soil description in the section "Descriptions of the Soils."

Data on particle-size distribution were obtained by the pipette method outlined by Steele and Bradfield (*10*), but sodium hexametaphosphate was used as the dispersing agent and a 10-gram soil sample was used. The sand fractions were determined by sieving. The fine silt and coarse clay (20-0.2 micron) were determined by sedimentation, and the fine clay (less than 0.2 micron) by sedimentation in a centrifuge. Coarse silt is obtained by subtracting sand, fine silt, and clay from the total sample. The percentage of organic matter was determined by a dry combustion method (*6*). Extractable bases were extracted with a neutral solution of ammonium acetate. The extractable potassium in this solution was determined by use of a flame photometer (*6*). Extractable calcium and magnesium in this solution were determined by the EDTA titration method (*3*). Extractable hydrogen, which also includes titratable aluminum, was determined by the triethanolamine method (*6*). The cation-exchange capacity was determined by adding the extractable cations. The calcium carbonate equivalent was determined titrimetrically by the procedure of Hutchison and MacLenna described by C. S. Piper (*7*). All pH measurements were made using a 1:1 soil-water ratio.

Del Rey Series

Profile description of Del Rey loam, in a nearly level cultivated field, sample number PT-35. Profile sampled to aid in identification of Del Rey soils. Sample data returned are within the range defined for the Del Rey series, but somewhat higher in sand content in the subsoil than is typical in the county.

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

B1—9 to 20 inches, yellowish-brown (10YR 5/6) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, fine and medium, subangular blocky structure; firm; many roots; neutral; diffuse, wavy boundary.

B21t—20 to 30 inches, grayish-brown (10YR 5/2) fine clay loam; many, medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; weak, fine and medium, subangular blocky structure; firm; thin patchy clay films on all ped faces; neutral; clear, wavy boundary.

TABLE 9.—*Laboratory*

[Laboratory analyses by the Agronomy Department, OARDC, Columbus, Ohio. Absence

Soil name, location, and sample number	Horizon	Depth	Particle-size distribution: Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Total sand (2.0–0.05 mm.)	Silt (0.05–0.002 mm.)
		Inches	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Del Rey loam: Blanchard Township, SE¼SW¼ sec. 32, T. 1 N., R. 8 E. Laboratory No. PT-35.	Ap	0–9	1.7	4.5	6.8	13.0	10.1	36.1	44.4
	B1	9–20	.6	2.4	5.8	9.6	6.7	25.1	37.5
	B21t	20–30	1.1	2.9	6.5	10.0	5.8	26.3	35.5
	B22t	30–38	.6	1.9	5.5	8.3	4.5	20.8	38.5
	C1	38–48	.6	2.2	8.2	9.9	5.0	25.9	40.8
	C2	48–56	2.1	3.1	2.9	6.9	6.4	21.4	48.9
	C3	56–68	2.9	3.5	2.9	7.2	5.7	22.2	52.3
	C4	68–80	3.3	4.3	3.3	8.1	7.5	26.5	40.2
Fulton silty clay loam: Greensburg Township, SE¼NE¼ sec. 24, T. 1 N., R. 6 E. Laboratory No. PT-26.	Ap	0–7	.4	1.5	1.1	2.1	1.7	6.8	60.0
	B&A	7–9	.6	1.6	1.0	1.8	1.3	6.3	50.5
	B21tg	9–15	.1	.6	.3	1.2	1.1	3.3	55.2
	B22tg	15–25	.1	.5	.3	.7	.8	2.4	54.8
	B3g	25–29	.6	.3	.3	.6	.6	1.9	54.4
	C	29–60	.1	.3	.2	.3	.3	1.2	55.7
Hoytville clay: Monterey Township, SE¼NW¼ sec. 36 T. 1 S., R. 4 E. Laboratory No. PT-22.	Ap	0–8	.5	1.3	1.7	4.7	4.0	12.2	43.5
	B21tg	8–17	.5	1.3	1.5	4.3	3.7	11.3	41.5
	B22tg	17–24	.4	1.2	1.5	4.2	3.3	10.6	40.4
	B23tg	24–35	.6	1.1	1.4	4.1	3.6	10.8	40.3
	B24tg	35–44	.6	1.3	1.6	4.2	3.7	11.4	41.0
	C1	44–60	.4	1.5	1.7	4.4	3.6	11.6	41.9
	C2	60–70	1.9	2.4	2.0	5.0	4.4	15.7	42.2
Nappanee silt loam: Monterey Township, SW¼ NW¼ sec. 36, T. 1 S., R. 4 E. Laboratory No. PT-21.	Ap	0–8	1.8	3.9	3.4	7.8	5.2	22.1	51.6
	A2g	8–11	2.1	3.8	3.0	6.9	4.8	20.6	47.5
	B21tg	11–19	.6	1.4	1.6	4.1	3.2	10.9	38.5
	B22tg	19–29	1.0	1.9	1.9	5.0	4.2	14.0	38.1
	B3t	29–34	1.7	1.9	1.8	4.8	4.4	14.6	42.5
	C	34–60	1.7	2.2	1.8	4.5	4.0	14.2	44.4
Paulding silty clay: Palmer Township, SW¼ SW¼ sec. 31, T. 2 N., R. 6 E. Laboratory No. PT-19.	Ap1	0–4	.2	.2	.1	.4	.6	1.5	42.0
	Ap2	4–8	.1	.1	.1	.3	.5	1.1	42.0
	B21g	8–14	.4	.4	.1	.3	.4	1.6	39.0
	B22g	14–20	.1	.6	.2	.3	.4	1.6	35.6
	B23g	20–26	.2	.2	.1	.3	.3	1.1	37.0
	B24g	26–32	.1	.2	.1	.3	.4	1.1	37.1
	B25g	32–38	.1	.2	.1	.3	.4	1.1	37.2
	B31g	38–44	.1	.2	.1	.3	.4	1.1	37.3
	B32g	44–60	1.8	1.5	.4	.4	.3	4.4	43.6
	C1g	60–70	.6	.5	.2	.3	.3	1.9	46.7
Roselms clay: Greensburg Township, SW¼ SW¼ sec. 32, T. 1 N, R. 7 E. Laboratory No. PT-20.	Ap	0–7	1.1	4.7	5.0	11.8	3.3	25.9	32.7
	B21t	7–13	.7	4.2	4.5	10.5	2.1	22.0	21.2
	B22t	13–19	.4	3.5	3.4	7.5	1.7	16.5	21.8
	B23t	19–24	.2	1.3	1.7	5.5	1.7	10.4	25.9
	B3	24–30	.2	1.0	1.2	3.7	1.1	7.2	28.0
	C	30–47	0.	.8	1.2	2.6	.7	5.3	26.1
Toledo silty clay: Blanchard Township, NW¼ NW¼ sec. 19, T. 1 N, R. 8 E. Laboratory No. PT-27.	Ap	0–8	.5	.8	.9	3.8	4.7	10.7	43.9
	B21g	8–16	.4	.7	.7	3.1	3.9	8.8	46.4
	B22g	16–26	.4	.7	.7	2.9	3.6	8.3	46.2
	B23g	26–39	.5	.8	.8	3.7	4.5	10.3	46.5
	B3g	39–55	.2	.7	.7	2.7	3.1	7.4	49.9
	Cg	55–80	.1	.3	.2	.3	.3	1.2	60.9

[1] Texture is silty clay but is near the silty clay and clay boundary.

analyses of selected soils

of an entry indicates that no determination was made. The symbol < means less than]

Particle-size distribution—Con.		Textural class	Reaction	Organic-matter content	Calcium carbonate equivalent	Extractable cations				Sum of extractable cations	Sum of bases	Base saturation
Clay (<0.002 mm.)	Fine clay (<0.0002 mm.)					Hydrogen	Calcium	Magnesium	Potassium			
Pct.	*Pct.*		*pH*	*Pct.*	*Pct.*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Pct.*
19.5	4.7	Loam	6.8	2.2	------	4.6	7.5	2.6	0.14	14.8	10.2	69
33.4	16.5	Clay loam	7.1	.7	------	3.4	13.6	4.8	.24	22.0	18.6	85
38.2	16.9	Clay loam	7.3	.7	.7	3.0	13.9	4.9	.26	22.1	19.1	86
45.7	17.7	Clay	7.5	------	.7	------	------	------	------	------	------	------
33.3	12.4	Clay loam	7.8	------	6.4	------	------	------	------	------	------	------
29.7	8.4	Clay loam	8.0	------	18.9	------	------	------	------	------	------	------
25.5	4.1	Silt loam	8.0	------	21.1	------	------	------	------	------	------	------
24.3	6.1	Loam	8.0	------	19.4	------	------	------	------	------	------	------
33.2	11.7	Silty clay loam	6.7	3.4	------	6.1	12.7	3.4	.39	22.6	16.5	73
34.2	9.5	Silty clay loam	6.1	2.2	------	7.1	9.9	4.1	.29	21.4	14.3	67
41.5	17.0	Silty clay	5.6	1.2	------	8.5	9.8	5.1	.29	23.7	15.2	64
42.8	17.9	Silty clay	6.5	.9	------	4.2	12.1	6.8	.25	23.3	19.1	82
43.7	17.9	Silty clay	7.2	.7	------	3.4	11.9	7.5	.23	23.0	19.6	85
48.1	14.1	Silty clay	7.8	------	13.8	------	------	------	------	------	------	------
44.3	18.3	Silty clay [1]	6.4	5.1	------	7.6	21.3	3.5	.51	32.9	25.3	77
47.2	16.9	Silty clay	6.6	2.2	------	4.2	18.3	3.7	.50	26.7	22.5	84
49.0	20.7	Silty clay	6.9	1.2	------	3.0	17.8	3.7	.47	25.0	22.0	88
48.9	20.2	Silty clay	7.3	------	.5	------	------	------	------	------	------	------
47.6	18.9	Silty clay	7.6	------	.7	------	------	------	------	------	------	------
46.5	16.2	Silty clay	7.6	------	1.8	------	------	------	------	------	------	------
42.1	12.6	Silty clay	7.7	------	12.0	------	------	------	------	------	------	------
26.3	7.8	Silt loam	5.2	3.4	------	10.0	6.1	1.8	.57	18.5	8.5	46
31.9	7.5	Clay loam	5.0	2.0	------	11.0	5.2	1.9	.31	18.4	7.4	40
50.6	24.5	Clay	4.7	1.0	------	13.3	10.2	3.8	.51	27.8	14.5	52
47.9	19.5	Clay	6.3	.9	------	4.8	14.6	4.6	.33	24.3	19.5	80
42.9	13.8	Silty clay	7.6	------	13.3	------	------	------	------	------	------	------
41.4	12.8	Silty clay	7.8	------	20.0	------	------	------	------	------	------	------
56.5	21.0	Silty clay	6.6	6.3	------	7.2	22.0	6.1	.69	36.0	28.8	80
56.9	21.9	Silty clay	7.0	5.8	------	5.9	20.8	5.9	.57	33.2	27.3	82
59.4	21.1	Clay	7.0	2.7	------	5.2	17.6	5.6	.61	29.0	23.8	82
62.8	24.5	Clay	7.0	1.4	------	4.4	18.5	6.1	.61	29.6	25.2	85
61.9	23.6	Clay	7.2	------	.5	------	------	------	------	------	------	------
61.8	24.4	Clay	7.3	------	.9	------	------	------	------	------	------	------
61.7	23.8	Clay	7.5	------	.5	------	------	------	------	------	------	------
61.6	24.5	Clay	7.7	------	1.6	------	------	------	------	------	------	------
52.0	15.7	Silty clay	7.8	------	23.4	------	------	------	------	------	------	------
51.4	13.7	Silty clay	7.8	------	20.6	------	------	------	------	------	------	------
41.4	16.0	Clay	5.8	3.2	------	10.0	6.0	6.8	.38	23.2	13.2	57
56.8	26.0	Clay	5.1	1.2	------	11.3	4.7	10.5	.24	26.7	15.4	58
61.7	28.2	Clay	6.3	1.0	------	5.5	6.6	14.9	.34	27.3	21.8	80
63.7	27.1	Clay	7.5	------	1.4	------	------	------	------	------	------	------
64.8	21.7	Clay	8.0	------	14.0	------	------	------	------	------	------	------
68.6	21.1	Clay	8.1	------	15.8	------	------	------	------	------	------	------
45.4	17.6	Silty clay	6.5	5.9	------	8.5	22.5	3.3	.66	35.0	26.5	76
44.8	15.7	Silty clay	7.0	2.4	------	5.1	21.2	3.8	.44	30.5	25.4	83
45.5	18.3	Silty clay	7.1	1.5	------	4.2	18.0	3.7	.43	26.3	22.1	84
43.2	17.3	Silty clay	7.3	------	.5	------	------	------	------	------	------	------
42.7	15.2	Silty clay	7.6	------	.5	------	------	------	------	------	------	------
37.9	10.2	Silty clay	7.9	------	11.7	------	------	------	------	------	------	------

B22t—30 to 38 inches, brown (10YR 5/3) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak and moderate, fine and medium, subangular blocky structure; firm; thin patchy clay films on vertical faces; mildly alkaline; clear, irregular boundary.

C1—38 to 48 inches, yellowish-brown (10YR 5/4) clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; friable; few fragments of black shale larger than 2 millimeters in diameter; mildly alkaline; calcareous; diffuse, wavy boundary.

C2—48 to 56 inches, dark yellowish-brown (10YR 4/4) clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/2) mottles; weak, fine and medium, subangular blocky structure; very firm; few fragments of black shale; moderately alkaline; calcareous; diffuse wavy boundary.

C3—56 to 68 inches, brown (10YR 4/3) silt loam; many, medium, faint, dark grayish-brown (10YR 4/2) mottles; weak, medium, subangular blocky structure; very firm; few fragments of black shale; moderately alkaline; calcareous; clear, wavy boundary.

C4—68 to 80 inches, brown (10YR 4/3) loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; moderate, fine and medium, platy structure; very firm; few fragments of black shale; calcareous; moderately alkaline.

Paulding Series

Profile description of Paulding silty clay, in a nearly level cultivated field, sample number PT-19. Profile sampled to aid in identification of Paulding soils. Sample data returned are within the range defined for the Paulding series, but the surface texture is silty clay rather than clay or silty clay loam, as is typical in the county.

Ap1—0 to 4 inches, very dark gray (10YR 3/1) silty clay, dark grayish-brown (10YR 4/2) crushed; moderate, fine and medium, subangular blocky structure; very firm; common roots; neutral; clear, wavy boundary.

Ap2—4 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay, dark grayish-brown (10YR 4/2) crushed; moderate, fine and medium, angular blocky structure; very firm; common roots; neutral; abrupt, wavy boundary.

B21g—8 to 14 inches, dark-gray (10YR 4/1) clay; few, fine, faint, brown (10YR 4/3) mottles and few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak and moderate, fine and medium, angular blocky structure; very firm; common roots; neutral; gradual, wavy boundary.

B22g—14 to 20 inches, gray (10YR 5/1) clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak and moderate, fine and medium, angular blocky structure; very firm; common roots; neutral; gradual, wavy boundary.

B23g—20 to 26 inches, gray (10YR 5/1) clay; common, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, fine, prismatic structure parting to moderate, fine and medium, angular blocky; very firm; few roots; neutral; gradual, wavy boundary.

B24g—26 to 32 inches, gray (10YR 5/1) clay; common, fine, prominent, brown (10YR 4/3) mottles; weak, fine and medium, prismatic structure parting to moderate, fine and medium, angular blocky; very firm; few roots; neutral; gradual, wavy boundary.

B25g—32 to 38 inches, gray (10YR 5/1) clay; many, fine and medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine and medium, prismatic structure parting to weak, fine and medium, angular blocky; very firm; continuous films occurring as flows along medium, major, vertical cracks; few roots; mildly alkaline; clear, wavy boundary.

B31g—38 to 44 inches, gray (10YR 5/1) clay; many, medium and fine, distinct, yellowish-brown (10YR 5/4) mottles and few, fine, prominent, yellowish-red (5YR 4/6) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangulair blocky; very firm; moderate continuous films occurring as flows along major vertical cracks; few roots; mildly alkaline; abrupt, wavy boundary.

B32g—44 to 60 inches, gray (10YR 6/1) silty clay; many, fine and medium, distinct, brown (10YR 4/3) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; very firm; moderate and thick continuous films occurring along major vertical cracks; few roots; mildly alkaline; calcareous; abrupt, wavy boundary.

C1g—60 to 70 inches, brown (10YR 5/3) silty clay; few, medium, prominent, greenish-gray (5GY 6/1) mottles and few, fine, faint, brown (10YR 4/3) mottles; massive; extremely firm; no roots; mildly alkaline; calcareous.

Roselms Series

Profile description of nearly level Roselms clay, in a cultivated field, sample number PT-20. Profile sampled to aid in identification of Roselms soils. Sample data returned are within the range defined for the Roselms series, but the surface texture is clay rather than silty clay loam or silt loam, as is typical in the county.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) clay; weak, fine and medium, granular structure; slightly hard; common roots; medium acid; abrupt, smooth boundary.

B21t—7 to 13 inches, grayish-brown (10YR 5/2) clay; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak to moderate, fine and medium, angular blocky structure; very firm; thin patchy clay films on vertical faces and along root channels; very firm; few roots; strongly acid; clear, smooth boundary.

B22t—13 to 19 inches, grayish-brown (10YR 5/2) clay; many, medium, distinct, brown (10YR 4/3) mottles; weak, medium, prismatic structure parting to weak, fine and medium, subangular blocky; very firm; thin patchy clay films on all faces and along root channels; few roots; slightly acid; gradual, wavy boundary.

B23t—19 to 24 inches, dark grayish-brown (10YR 4/2) clay; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, prismatic structure parting to weak, fine and medium, angular blocky; very firm; thin patchy clay films on all faces and along root channels; few roots; mildly alkaline; abrupt, wavy boundary.

B3—24 to 30 inches, dark grayish-brown (10YR 4/2) clay; many, fine, faint, dark yellowish-brown (10YR 4/4) mottles; very weak, medium, prismatic structure grading to massive; very firm; few roots; thin continuous clay films along root channels and on vertical faces; moderately alkaline; calcareous; gradual, wavy boundary.

C—30 to 47 inches, dark-gray (10YR 4/1) clay; many medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; extremely firm; moderately alkaline; calcareous.

General Nature of the County

This section provides general information about the county. It discusses history, climate and geology. It also gives facts about transportation and farming.

History

Putnam County was created and named for General Rufus Putnam in 1820, but it was not officially organized until 1834. The county was originally 24 miles square, or 576 square miles, but adjustments were made when Auglaize and Allen Counties were created, and the county now contains 486 square miles. Ottawa, the county seat, is the largest town.

At first, farming developed slowly because methods had to be devised for draining the extensive areas of wet, level soils that covered much of the county. This area was a part of the Black Swamp in the northwestern part of Ohio. After the late 1800's, however, when the installation of drainage ditches and tile drains was started, farming developed rapidly. The clearing and draining of the soils has continued to the present and now includes some of the remaining woodland. The drained areas are used mostly for crops, and a large part of the county is cultivated.

Climate [4]

Although Pandora is located in the southeastern part of Putnam County, the weather data given in tables 10 and 11 are representative of the entire county. The climate of this area is marked by large annual, daily, and day-to-day ranges in temperature. Lake Erie lies about 50 miles to the northeast, but the presence of the lake has little effect on the climate of Putnam County.

Summers are moderately warm and humid throughout the county; temperatures exceed 89° F. on an average of 17 days. Winters are reasonably cold and cloudy, and an average of 5 days has subzero temperatures. Average extreme annual temperatures given in table 10 differ from those in any month because the annual extremes in temperature do not occur in the same month each year.

Precipitation in Putnam County varies widely from year to year, but it normally is abundant and well distributed throughout the year. Fall is the driest season. Showers and thundershowers account for most of the rainfall during the growing season. Thunderstorms occur on about 40 days each year and are most frequent from April through August. Heavy rains of 2.0, 2.6, 3.1, 3.6, 4.0, and 4.4 inches in 24 hours can be expected to occur at least once in 2, 5, 10, 25, 50, and 100 years, respectively. Sums of the values of the 12 one-year-in-10 columns in table 10 do not equal the annual values, because all dry and wet months do not occur in the same year. During any year, snowfall is likely to fluctuate widely from the monthly and annual averages.

Except for small grain and hay, crops generally are planted from mid-April through mid-June. During a 10-year period, rainfall in excess of 1.2 inches per week can be expected eight times in April, 11 times in May, and 12 times in June. Rains of this magnitude delay field operations and may cause soil loss because they occur during the time of year when vegetative cover is most nearly lacking.

Soil moisture goes through a seasonal cycle each year that is almost independent of the amount of precipitation received. It reaches its lowest point in October and is replenished in winter and early in spring, when precipitation exceeds water lost by evaporation. Since the water needs of all crops reach a maximum in July and August, and rainfall is almost always insufficient to meet those needs, the drying of all soils is progressive.

A drought may occur when evaporation greatly exceeds precipitation for long periods. During 1929-68, extended periods of moderate to extreme drought in the northwestern part of Ohio, as determined from the Palmer Drought Severity Index, occurred during the growing seasons of 1930, 1931, 1932, 1934, 1935, 1936, 1941, 1953, 1954, 1963, 1964, and 1965. The longest continuing period of moderate to extreme drought in the northwestern part of Ohio was 34 months (October 1962-July 1965).

[4] Prepared by MARVIN E. MILLER, climatologist for Ohio, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation*

[All data from Pandora; period of record, 1950-66]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average highest	Average lowest	Average total	One year in 10 will have—		Average snowfall	Average number of days with 1 inch or more of snow
						Less than—	More than—		
	°F.	°F.	°F.	°F.	In.	In.	In.	In.	
January	34	18	55	−4	2.74	0.88	5.05	7.3	3
February	37	20	58	0	2.51	1.01	4.31	6.8	2
March	45	27	68	7	3.09	1.30	5.22	7.2	2
April	60	38	80	21	3.70	1.83	5.89	1.7	1
May	72	48	87	32	3.06	1.49	4.89	0	0
June	82	57	93	42	3.22	1.66	5.01	0	0
July	84	61	93	48	3.50	2.22	4.89	0	0
August	83	58	93	43	2.49	1.01	4.27	0	0
September	77	52	92	32	2.62	.93	4.69	0	0
October	66	41	83	23	2.45	.48	5.09	0	0
November	50	32	69	13	2.67	1.16	4.43	4.1	2
December	37	21	60	−1	2.20	.80	3.91	7.6	2
Year	60	39	96	−8	34.25	25.65	43.50	34.7	12

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[Based on data for the period 1950–66]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	March 31	April 13	April 18	May 1	May 22
2 years in 10 later than	March 27	April 9	April 15	April 27	May 17
5 years in 10 later than	March 16	March 28	April 8	April 19	May 5
Fall:					
1 year in 10 earlier than	November 15	October 20	October 17	October 3	September 18
2 years in 10 earlier than	November 19	October 26	October 21	October 7	September 21
5 years in 10 earlier than	November 27	November 9	October 30	October 15	September 28

Generally, humidity rises and falls inversely with the daily temperature and is lowest in summer and highest in winter. For the year, relative humidity averages about 80 percent at 1 a.m. and 7 a.m., 60 percent at 1 p.m., and 70 percent at 7 p.m. During summer afternoons the relative humidity often ranges from 50 to 60 percent. Cloudiness is greatest in winter and least in summer. This seasonal variation is most clearly illustrated by the percentage of possible sunshine, which is about 70 percent in July and 35 percent in December and January. Damaging winds of 35 to 85 miles per hour occur most often during spring and summer. Since 1900, five tornadoes have been reported in Putnam County.

Geology

The present landforms in the county are mainly the result of glaciation during the Pleistocene epoch. This glaciation occurred late in the Wisconsin age and apparently was the last to deposit glacial materials in this county. Radiocarbon dating of material from the northern part of Ohio and Indiana indicates that the last glacier receded from this area about 15,000 years ago (*5*). For a time the glacier remained stationary near the northern border of Ohio. The ice then acted as a dam, and the melt waters formed shallow, large lakes that remained for extended periods, until the present outlet to Lake Erie was reestablished.

Most of Putnam County was affected by at least two glacial lakes. Lake Maumee, having several stages and a high elevation of 800 feet above sea level, covered all of the county except the Ft. Wayne ground moraine, which is south of State Route No. 12 in the southeastern part of the county. Lake Whittlesey, having an elevation of about 738 feet above sea level, also covered part of the county. Some prominent sandy and gravelly beach ridges were left along the margins of these lakes (*4*). Several of the more obvious beach ridges in Putnam County can be observed along State Route No. 12 and from Leipsic to the Hancock County line, along State Route No. 613, and along County Road Y in the vicinity of Belmore. The lake-laid sediment is underlain by glacial till that has been reworked to varying degrees by water.

The bedrock underlying the glacial till is limestone of the Monroe Formation in all the county except the northwest corner, where it is underlain by Devonian limestone and shale. The depth to bedrock ranges from 2 feet or less along Riley Creek south of Pandora to 80 feet or more in other parts of the county.

Transportation

Early transportation was provided by the Miami-Erie Canal, which was completed in 1843. This canal was operated until the turn of the century but was profitable only until the railroads were built. Most of the railroads were built between 1850 and 1900. Operating today and serving a number of the communities in the county are lines of three railroads.

One Federal Highway, U.S. No. 224, is a major traffic artery across the county. Several State highways, Ohio Routes No. 12, 15, 115 and 613, extend across the county and provide good traffic links between the communities of the county. Most county and township roads are paved with blacktop.

Farming

The total acreage of this county is 311,040 acres. In 1964, according to the U.S. Census of Agriculture, 294,286 acres was in farms. For more than a decade, the number of farms has been decreasing and the size of the average farm has been increasing. Many farms have been combined with other farms. In 1969 the farms numbered 1,975 and an average farm consisted of 154.9 acres. The general trend has been toward a decrease in general farming and raising of livestock and an increase in production of cash-grain crops. Farms having many acres of cash-grain crops generally can be operated by one or two workers, because heavy power equipment can be used on nearly all the soils.

Since 1959 the number of acres in cropland has increased slightly, and the number of acres in permanent pasture and woodland has decreased slightly. The acreage of soybeans and wheat has increased, but the acreage of corn, oats, and barley has decreased. Except for poultry, the number of livestock has decreased. Many farms have no livestock. In 1969 the number of livestock on farms in the county was as follows:

Kind of livestock:	*Number*
Cattle and calves	20,686
Hogs and pigs	57,715
Sheep and lambs	6,718
Chickens	571,304

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Glossary

Aeration, soil. The exchange of air in the 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 and lower in oxygen.

Acidity. See Reaction.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. In this survey available water capacity is rated as follows for a root zone restricted at a depth of 60 inches: very low, less than 3 inches of water; low, 3 to 6 inches; medium, 6 to 9 inches; high, 9 to 12 inches; and very high, more than 12 inches.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Flood plain. Nearly level land, consisting of stream sediment, that borders a stream. It is subject to flooding unless protected artificially.

Glacial lake (geology). An ancient lake, now dry or almost dry, formed by a glacier. A glacial lake has fine debris on its floor that was deposited by melt water.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Illuviation. The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from the horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into it from the A horizon above, the B horizon is called an illuvial horizon.

Infiltration. The downward entry of water into the surface of soil or other material, as contrasted with percolation, which is the movement of water through soil layers or material.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Lake plain (geology). A plain formed where the braided courses of glacial streams carry rock flour, or finer material, far beyond the front of the glaciers and build flood plain deposits or spread the finer material in lakes as extensive deltas and bottom deposits. The lake plain forms where the rock flour is deposited in lakes.

Lamella. Soil material in the form of a sheetlike layer.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Moraine, ground (geology). Glacial till somewhat beneath the advancing ice and deposited from it during its dissolution, rather than aggregated in a thickened belt at the ice edge; the deposit is relatively thin and characteristically forms an undulating plain with gently sloping swells, sags, and closed depressions.

Mottling, soil. 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.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Organic matter. A general term for plant and animal material in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stages of rapid decomposition.

Parent material. Disintegrated and partly weathered rock 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.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Root zone. The part of the soil that is penetrated, or can be penetrated, by plant roots. In this survey, root zone classes in inches are as follows: *Shallow,* more than 20 inches; *moderately deep,* 20 to 40 inches; and *deep,* 40 to 60 inches.

Sand. Individual rock or mineral fragments in a soil that range in diameter 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.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed, or arranged in strata, or layers, such as stratified alluvium. The term is confined to the 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 either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing 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 noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area 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.

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