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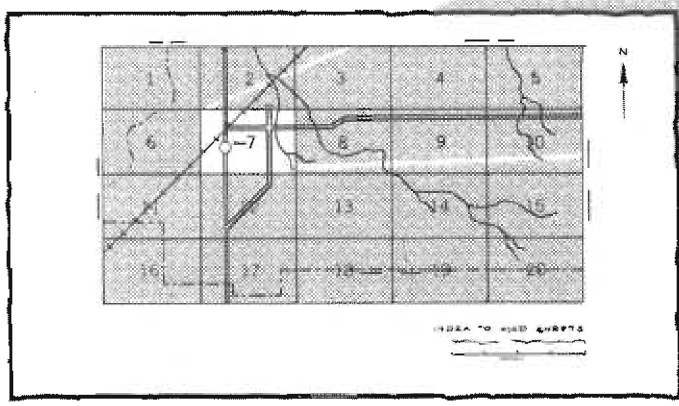
soil survey of

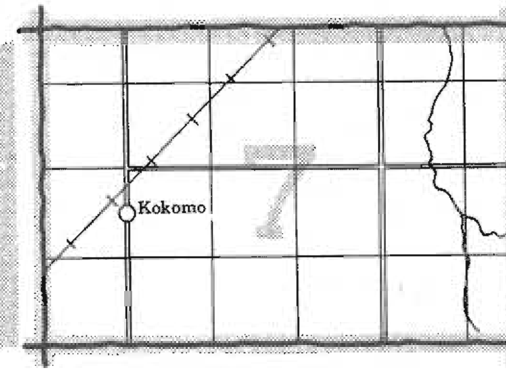
lucas county, ohio

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

HOW TO US

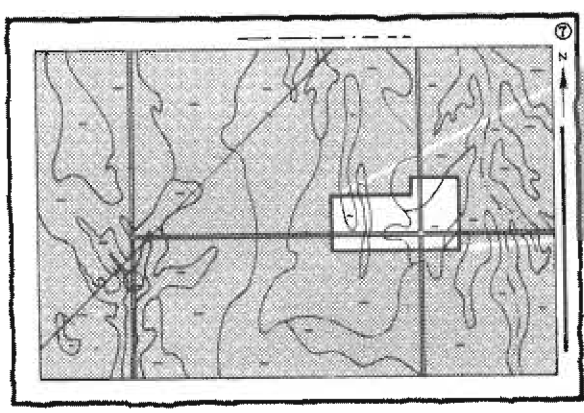
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

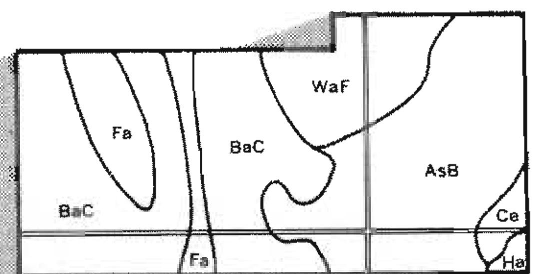




2. Note the number of the map sheet and turn to that sheet.

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





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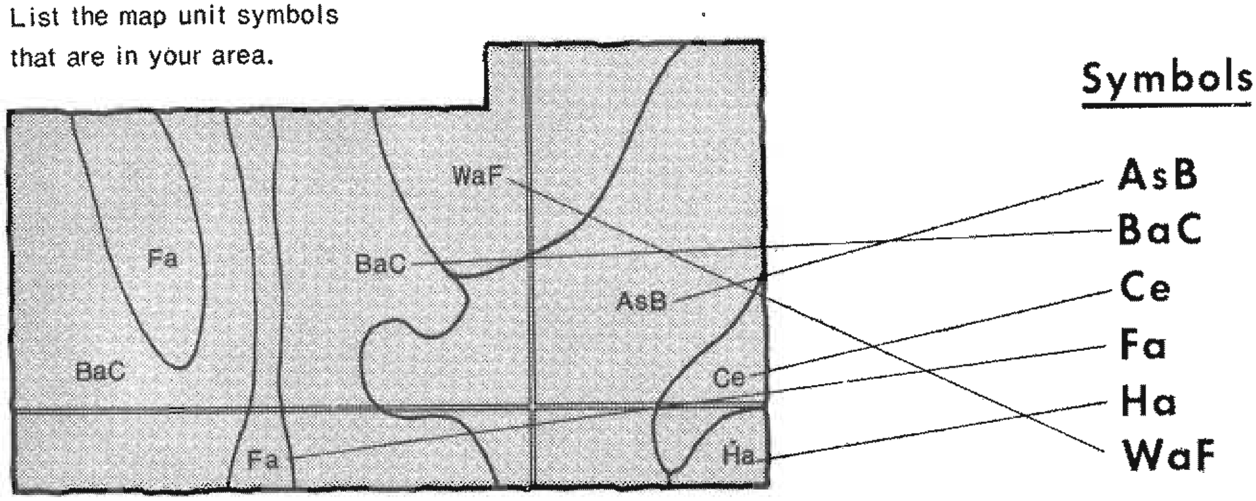
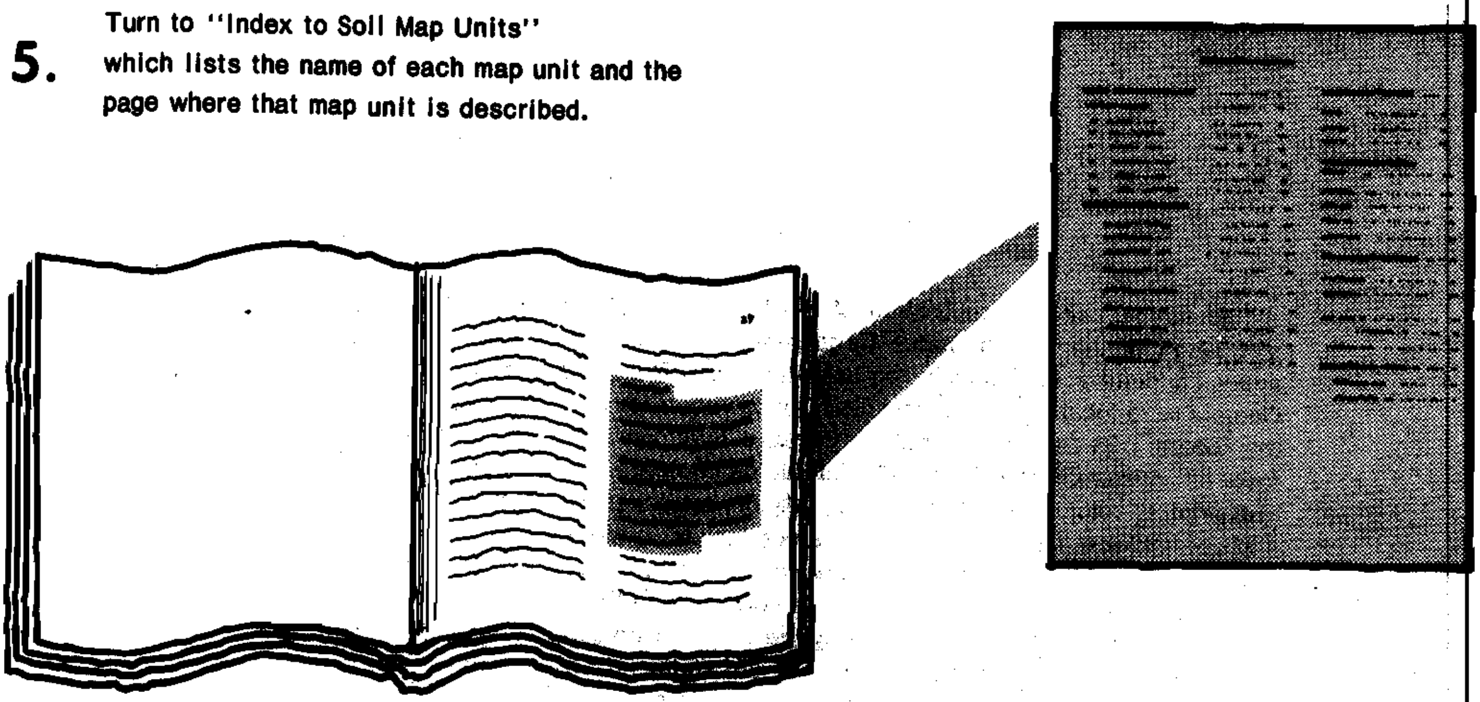
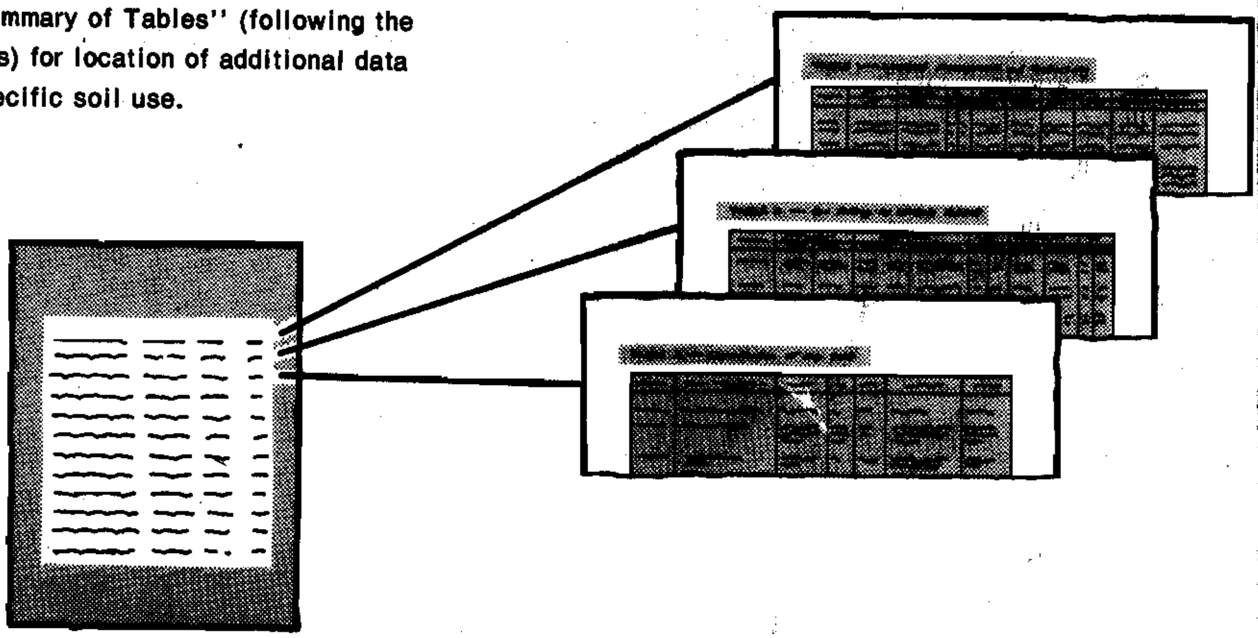


THIS SOIL SURVEY

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



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Research and Development Centers, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1973 to 1976. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1976. 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 Lucas Soil and Water Conservation District. Funds and facilities for the completion of this survey were provided by the Lucas County Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1980 O—298-172

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Issued June 1980

Index to map units

Summary of tables

Summary of tables—Continued

Foreword

We introduce the Soil Survey of Lucas County, Ohio. You will find, herein, basic information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared to meet the needs of different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

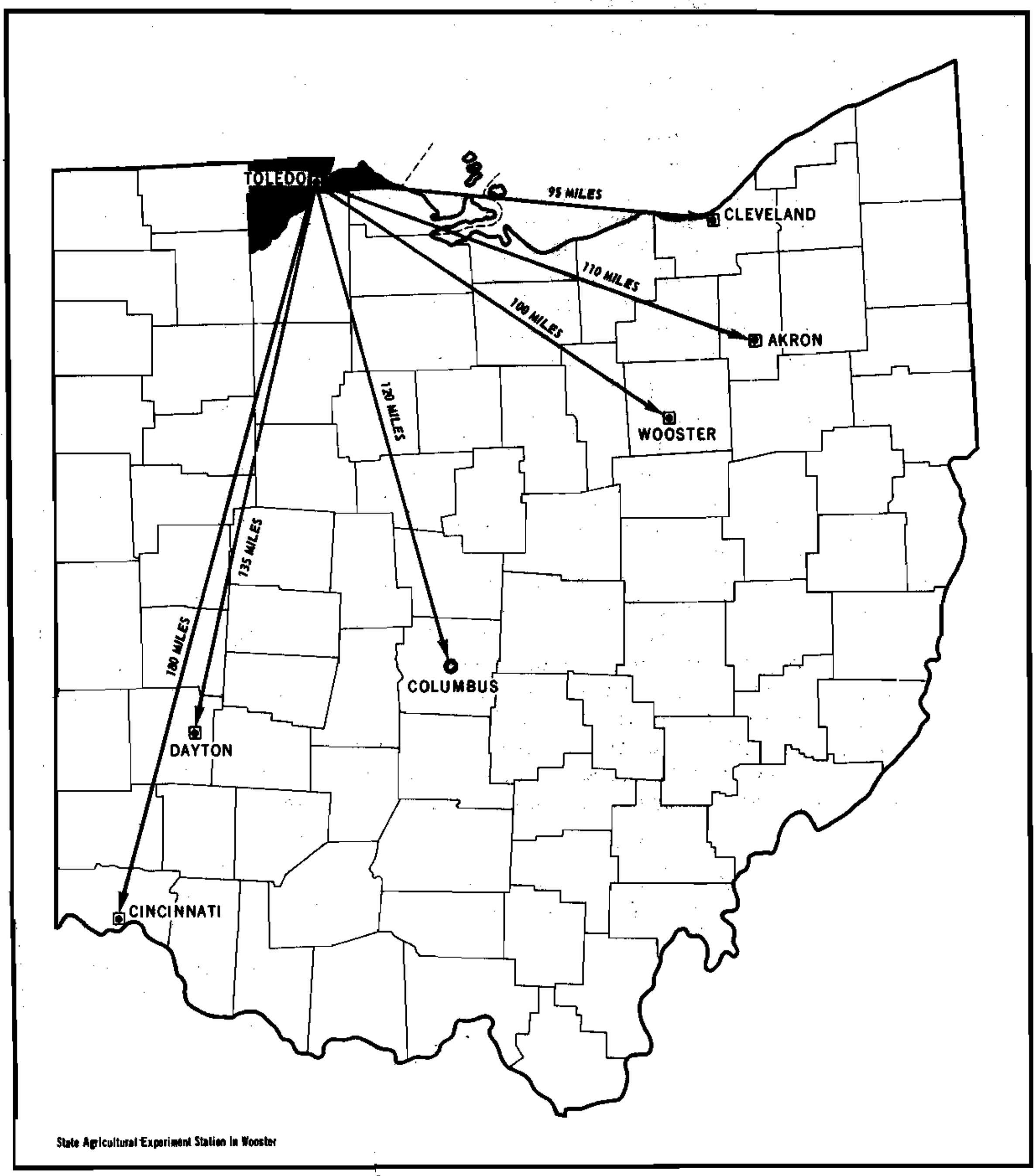
Many people assume that soils are all somewhat alike. They are unaware that great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. This publication also shows, on the general soil map, the location of broad areas of soil and, on detailed soil maps, the location of each kind of soil. It provides descriptions of each kind of soil in the survey area and gives much information about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

We believe that this soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Robert E. Quilliam

Robert E. Quilliam
State Conservationist
Soil Conservation Service



Location of Lucas County in Ohio.

soil survey of

Lucas County, Ohio

by Kenneth L. Stone, Edwin H. McConoughey, George D. Bottrell, and Daniel J. Crowner, Soil Conservation Service

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

General nature of the county

This section provides general information about the settlement, geology, relief, water resources, climate, natural vegetation, and agriculture of Lucas County.

Settlement

Lucas County is in the northwestern part of Ohio, adjacent to Lake Erie and the state of Michigan. The county was established in 1835. Toledo is the county seat.

In the 1820's, settlers began farming on the river bottoms, once used by the Indians for corn. When the Miami and Erie Canal was completed, trade in the area quickly expanded, and Toledo became a major shipping port. The Black Swamps area was drained by German immigrants using ditches and tile, and this area was transformed into a garden spot.

Geology

The soils in Lucas County are postglacial in origin. The glacial-lake landscape is characterized by the sandy beach ridges and dunes of the Oak Openings, which extends northeast-southwest from Sylvania to Neapolis. The area to the northwest of the Oak Openings is a glacial ground moraine, and the area to the southeast is the lake plain of old Lake Erie.

Most of the bedrock in Lucas County is at a depth of 20 to 160 feet. It is near the surface mainly in the northern and southern parts of the county at Waterville, Whitehouse, Maumee, and Sylvania. This bedrock is mainly limestone or dolomite, and it is quarried in many places. Calcareous sandstone is near the surface in the area east of Whitehouse and west of Sylvania.

The Oak Openings is commercially used as a source of sand. The Maumee River bed is commercially used as a source of gravel. The amount of gravel in this source varies within short distances.

Physiography, relief, and drainage

Lucas County is on a nearly level plain. The landscape slopes gently to the southeast toward the Maumee River and northeast toward Lake Erie. The Oak Openings extends northeast-southwest from Sylvania to Neapolis. This area is a belt 5 to 10 miles wide where the flat surface is broken by low, rounded hills, or undulations, of sand.

The flat area in the northwestern part of the county is a glacial ground moraine that was reworked by wave action in an old glacial lake. The surface here is broken only by Ten Mile Creek. The area of rolling sand has numerous pockets or low areas and is dissected by Swan Creek, Blue Creek, and Ten Mile Creek.

The flat glacial-lake surface west of the Maumee River is broken by a few limestone and sandstone ridges and by major streams. The flat area of lake deposits east of the Maumee River is dissected by Duck, Otter, Cedar, and Crane Creeks. The slope breaks of these creeks are short and steep.

Water resources

Lake Erie is the main source of water in Lucas County. Besides being used for recreation, Lake Erie supplies water to the cities of Toledo and Oregon. The Maumee River is another source of water.

The main supply of ground water is in the sandy area of the county, where water collects above the impervious glacial till. This water is at a depth of about 15 to 25 feet. In this area, many ponds have been established by excavating pits to a depth below the water table. The ponds are used for recreation and as a water supply. About 345 acres in Lucas County is used for ponds. Some of these ponds have been built in areas of clayey soils.

Some old quarries and borrow pits are filled with water, but they are used only for recreation. The streams in the survey area are usually at low flow late in summer and in fall, and they have a high content of pollutants.

Studies of the underground water supply (*11*) by the Division of Water and Geological Survey of the Ohio Department of Natural Resources have determined that most of the water-bearing bedrock is dolomite. The amount of water in this rock depends on the size and number of cavities or small crevices in the rock.

Climate

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

Lucas County is cold in winter and warm and occasionally hot in summer. Precipitation is well distributed throughout the year and is adequate for most crops on most soils. There is a moderate precipitation peak in summer. Winter precipitation is mainly snow. There are occasional blizzards.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Toledo, Ohio in the period 1955 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 26 degrees F, and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Toledo on January 24, 1963, is -17 degrees. In summer the average temperature is 70 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on June 28, 1971, is 99 degrees.

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

Of the total annual precipitation 18 inches, or 55 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 24 inches. The heaviest 1-day rainfall during the period of record was 4.34 inches at Toledo on July 4, 1969. Thunderstorms occur on about 58 days each year, and most occur in summer.

Average seasonal snowfall is 37 inches. The greatest snow depth at any one time during the period of record (1956-1975) was 12 inches. On an average of 29 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 65 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the west-southwest. Average windspeed is highest, 11 miles per hour, in April.

Severe thunderstorms occur occasionally; tornadoes are rare. Both usually are local and of short duration, and they cause damage in a variable pattern.

Natural vegetation

The natural vegetation of Lucas County is deciduous forest. The two major types of forest in the county are the Oak forest and the Elm-Ash swamp forest.

The Oak forest occurs naturally mainly in the Oak Openings. In this area, northern red oak, white oak, sugar maple, black oak, and white ash are predominant, and there are scattered basswood and shagbark hickory. A few swampy areas of grass also are scattered throughout this area.

The Elm-Ash swamp forest is associated with the Black Swamp, but it also occurs in other areas of wet soils. The dominant trees are American elm and several species of ash and maple. Cottonwoods and sycamores are included in some forests. Wet-prairie land is scattered throughout areas of this forest type.

Agriculture

Agriculture is a major industry in Lucas County. In 1974, according to the Census of Agriculture of that year, 98,418 acres, or about 45 percent of the land area in the county, was in farms.

From 1969 to 1974, the number of farms decreased slightly, and the average size of farms increased. Farms less than 179 acres in size decreased in number, while those more than 500 acres in size almost doubled. The number of part-time farms decreased during this period. The acreage of woodland and pasture decreased, but the acreage of harvested cropland increased by about 15 percent. The number of all livestock, except chickens and horses and ponies, has decreased, and many farms no longer have livestock.

In 1974, 25,934 acres was in corn, 12,079 acres in wheat, 38,245 acres in soybeans, 1,844 acres in hay, 1,151 acres in Irish potatoes, and 2,952 acres in vegetables. There were 3,035 cattle and calves, 9,107 hogs and pigs, 227 sheep and lamb, 458 horses and ponies, and 145,472 chickens (*10*).

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, or underlying material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

The names, descriptions, and delineations of soils in this survey do not necessarily agree or join fully with those in surveys of adjoining counties. Differences result from a better knowledge of soils or from modification and refinements in the concept of soil series. Other differences result from the predominance of different soils in taxonomic units consisting of soils of two or more soil series and from differences in the range in slope allowed within the map units of different surveys. In addition, the correlation of a recognized soil is based on the acreage of that soil and its dissimilarity to adjacent soils within the survey area. In mapping, it is often more feasible to include soils that are minor in extent with similar soils that require similar management than to correlate these minor soils separately.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas, or associations, that have a distinctive pattern of soils, relief, and drainage. Each association on the general soil map is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

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

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

The nine associations in this survey have been placed into four general groups for broad interpretive purposes.

Each of the broad groups and the associations in each group are described on the following pages.

Descriptions of map units

Areas dominated by level to gently sloping, loamy and clayey soils on lake plains

This group of four associations makes up about 34 percent of the county. The soils are level to gently sloping and are very poorly drained and somewhat poorly drained. They formed in clayey and loamy lake-laid sediment and water-reworked glacial till on broad flats of an old glacial lake. These soils are used mainly as cropland. In some areas, they are in urban uses. Seasonal wetness is the main limitation of these soils. The wetness and restricted permeability are limitations to building site development and sanitary facilities.

1. Latty-Toledo-Fulton association

Level to gently sloping, very poorly drained and somewhat poorly drained soils that formed in clayey glacial lake sediment

The soils in this association are on the broad, flat lake plain in the eastern part of the county. In some areas, they are on the side slopes of stream valleys and major drainageways.

This association makes up about 17 percent of the county. It is about 50 percent Latty soils, 20 percent Toledo soils, 10 percent Fulton soils, and 20 percent minor soils (fig. 1).

Latty and Toledo soils are very poorly drained and are on broad, level flats and in poorly defined drainageways. Fulton soils are somewhat poorly drained. They are nearly level to gently sloping and are on low rises. The

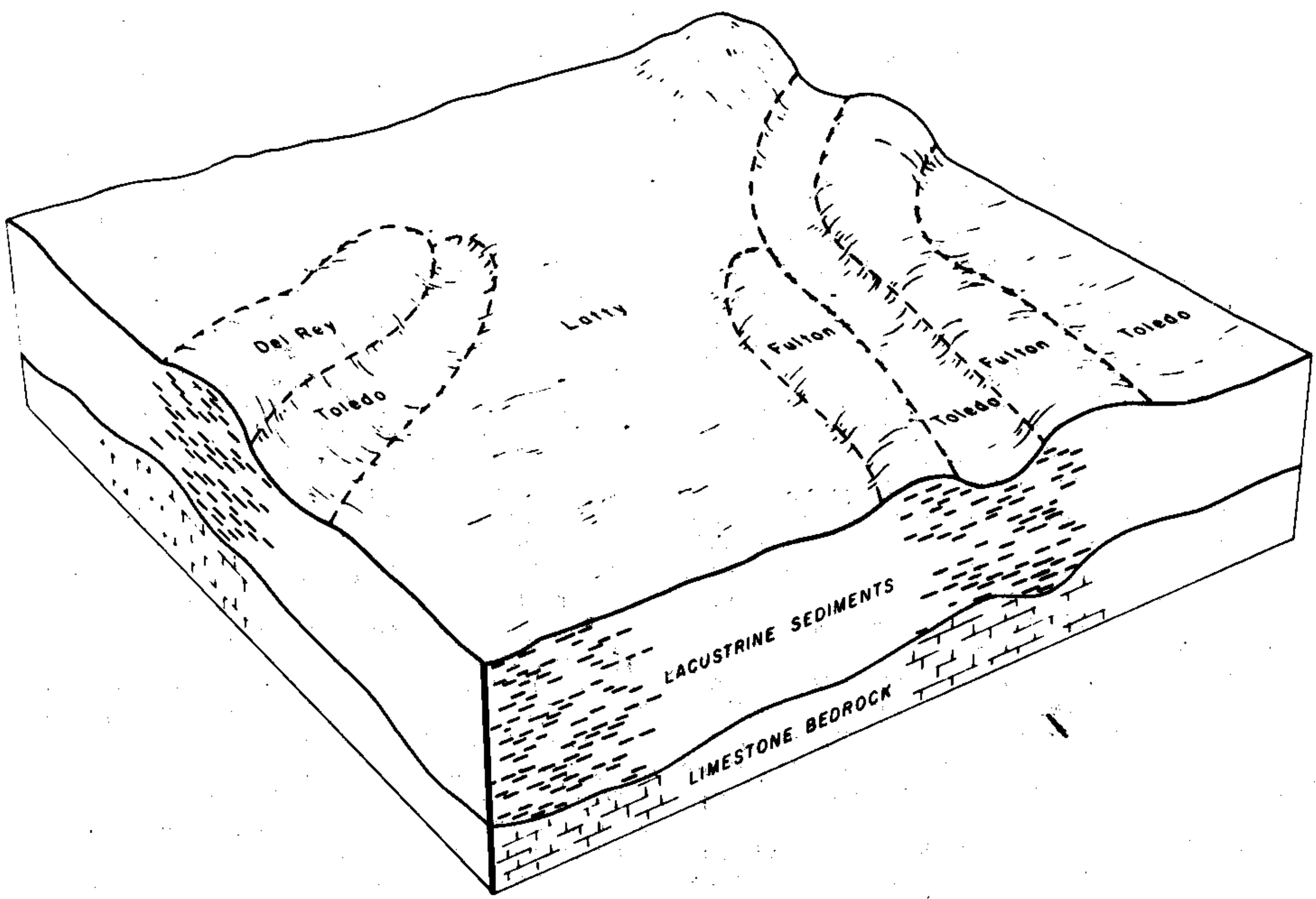


Figure 1.—Typical pattern of soils and parent material in the Latty-Toledo-Fulton association.

soils in this association have slow to very slow permeability and a seasonal water table near the surface.

The minor soils in this association are the Del Rey, Haskins, Nappanee, and Sloan soils. Also included are some areas of Urban land. The Del Rey, Haskins, and Nappanee soils are somewhat poorly drained and are on low rises. The Sloan soils are in small areas on narrow flood plains.

The Latty, Toledo, and Fulton soils are limited for many uses mainly because of wetness caused by the seasonal high water table and the slow to very slow permeability. Unless the Toledo soils are adequately drained, water ponds on the surface during extended wet periods.

If the soils in this association are adequately drained, they are well suited to use as cropland. The main crops are corn, soybeans, and wheat. Tomatoes and sugar beets are the main specialty crops.

These soils are severely limited for many engineering uses by the seasonal wetness and the slow to very slow permeability.

2. Del Rey-Lenawee association

Level and nearly level, somewhat poorly drained and very poorly drained soils that formed in clayey and loamy glacial lake sediment

The soils in this association are on broad, flat lake plains. They are mainly level or nearly level. Included in this association are some areas of sloping soils on the side slopes of the Ottawa and Maumee Rivers and Swan Creek.

This association makes up about 4 percent of the county. It is about 40 percent Del Rey soils, 35 percent Lenawee soils, and 25 percent minor soils.

Del Rey soils are somewhat poorly drained and are on broad flats and low rises. Lenawee soils are very poorly drained and are on broad flats and in poorly defined drainageways. These soils have slow or moderately slow permeability and a seasonal water table near the surface.

The minor soils in this association are the Haskins, Dixboro, Fulton, Sisson, St. Clair, Eel, Ross, Shoals, and Sloan soils. The Haskins, Dixboro, and Fulton soils are somewhat poorly drained and are on low rises. The Sisson soils are well drained, and the St. Clair soils are moderately well drained; these soils are on the side slopes of Swan Creek and the Ottawa and Maumee Rivers. The Eel, Ross, Shoals, and Sloan soils are in small areas on flood plains and on some small islands.

Del Rey and Lenawee soils are limited for many uses mainly because of the slow or moderately slow permeability and the wetness caused by the seasonal high water table. Unless the Lenawee soils are adequately drained, water ponds on the surface during extended wet periods.

If the soils in this association are adequately drained, they are well suited to use as cropland. The main crops are corn, soybeans, and wheat. Sugar beets are the main specialty crop.

These soils are limited for many engineering uses by the seasonal wetness and the slow or moderately slow permeability. They are subject to flooding along major drainageways and on the islands. The walls of shallow excavations tend to slump. The soils have low potential for recreation uses because of the seasonal wetness.

About 25 percent of the acreage of this association is used for houses, streets, parking lots, and other urban structures. Within city limits there are open areas where the soils have not been disturbed. These areas include parks, playgrounds, and yards.

3. Toledo-Fulton association

Level to gently sloping, very poorly drained and somewhat poorly drained soils that formed in clayey glacial lake sediment

The level to gently sloping soils in this association are on broad, flat lake plains. Included are some areas of more sloping soils on the side slopes adjacent to Swan Creek and the Maumee River.

This association makes up about 4 percent of the county. It is about 40 percent Toledo soils, 15 percent Fulton soils, and 45 percent minor soils.

Toledo soils are very poorly drained and are on broad, level flats and in poorly defined drainageways. Fulton soils are somewhat poorly drained and are on low rises and ridges. The soils in this association have slow or very slow permeability and a seasonal water table near the surface.

The minor soils in this association are the Lenawee, Mermill, Del Rey, Haskins, Rimer, St. Clair, Eel, Ross, Sloan, and Shoals soils. Also included are areas of Urban land. The Lenawee and Mermill soils are very poorly drained and are in drainageways and on narrow flats. The Del Rey, Haskins, and Rimer soils are somewhat poorly drained and are on low knolls. The St. Clair soils are moderately well drained and are on the side slopes of Swan Creek and the Maumee River. The Eel, Ross, Sloan, and Shoals soils are on flood plains and small islands.

Toledo and Fulton soils are limited for many uses mainly because of the slow or very slow permeability and the wetness caused by the seasonal high water table. Unless the Toledo soils are adequately drained, water commonly ponds on the surface during extended wet periods.

If the soils in this association are adequately drained, they are well suited to use as cropland. The main crops are corn, soybeans, and wheat. Sugar beets is the main specialty crop.

These soils are severely limited for many engineering uses by the seasonal wetness and the very slow or slow permeability. The high shrink-swell potential also is a limitation. Flooding is a hazard along Swan Creek and the Maumee River. The soils have low potential for extensive recreation uses because of the seasonal wetness.

About 25 percent of the acreage of this association is used for houses, streets, parking lots, and other urban structures. Within city limits there are open areas where the soils have not been disturbed. These areas include parks, playgrounds, and yards.

4. Hoytville-Nappanee-Mermill association

Level or nearly level, very poorly drained and somewhat poorly drained soils that formed in clayey and loamy waterworked glacial till

The soils in this association are in broad, flat areas where glacial till was deposited and then reworked by lake action. These soils are mainly level or nearly level. Included in this association are some areas of more sloping soils on the side slopes of major drainageways.

This association makes up about 9 percent of the county. It is about 55 percent Hoytville soils, 15 percent Nappanee soils, 10 percent Mermill soils, and 20 percent minor soils (fig. 2).

Hoytville and Mermill soils are very poorly drained and are on broad, level flats and in poorly defined drainageways. Nappanee soils are somewhat poorly drained. They are nearly level and are on low rises. Hoytville and Nappanee soils have moderately slow to very slow permeability. Mermill soils have moderate permeability in the upper part of the soil and slow or very slow permeability in the lower part. The soils in this association have a seasonal water table near the surface.

The minor soils in this association are the Haskins, Metamora, Rimer, and Seward soils. Haskins, Metamora,

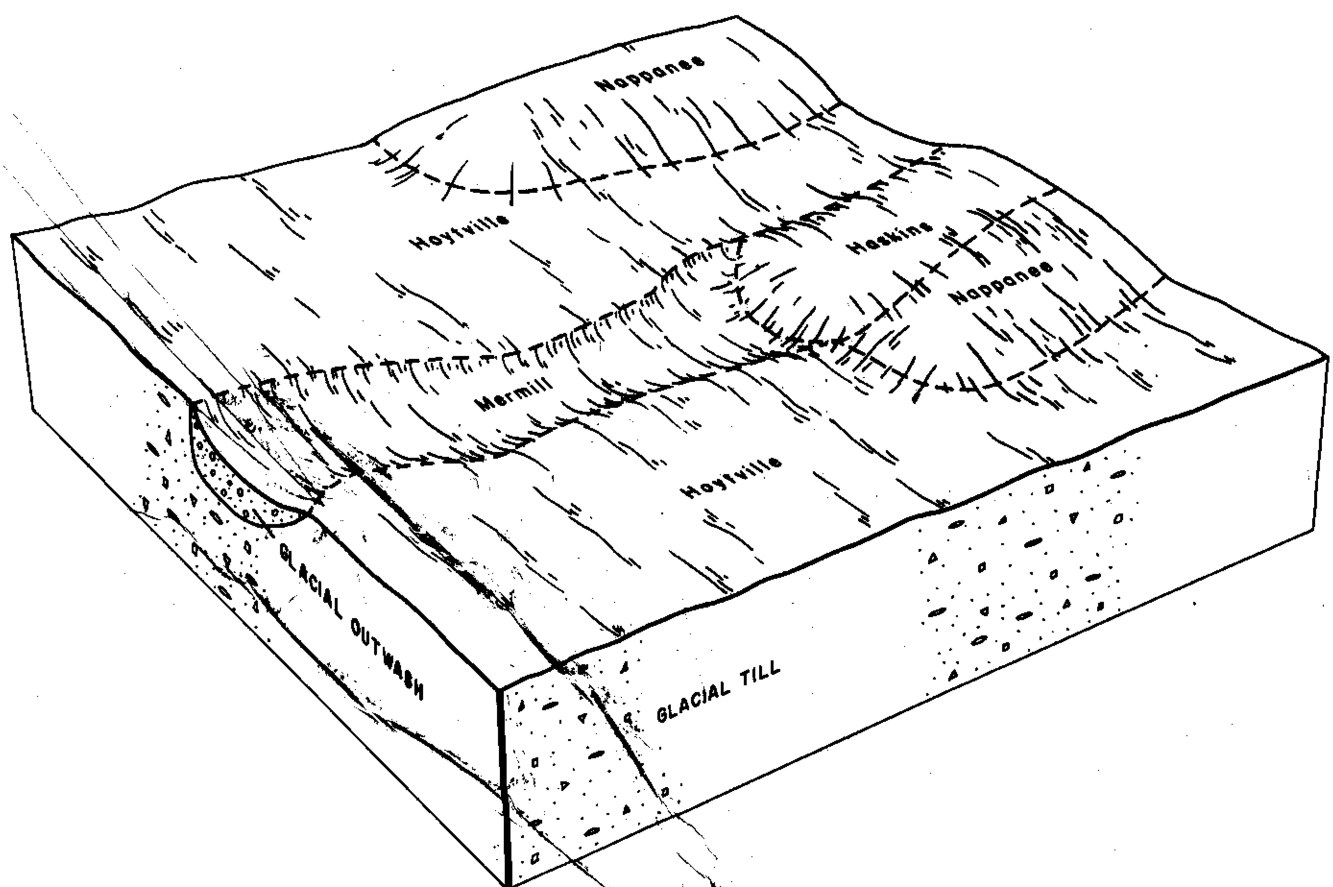


Figure 2.—Typical pattern of soils and parent material in the Hoytville-Nappanee-Mermill association.

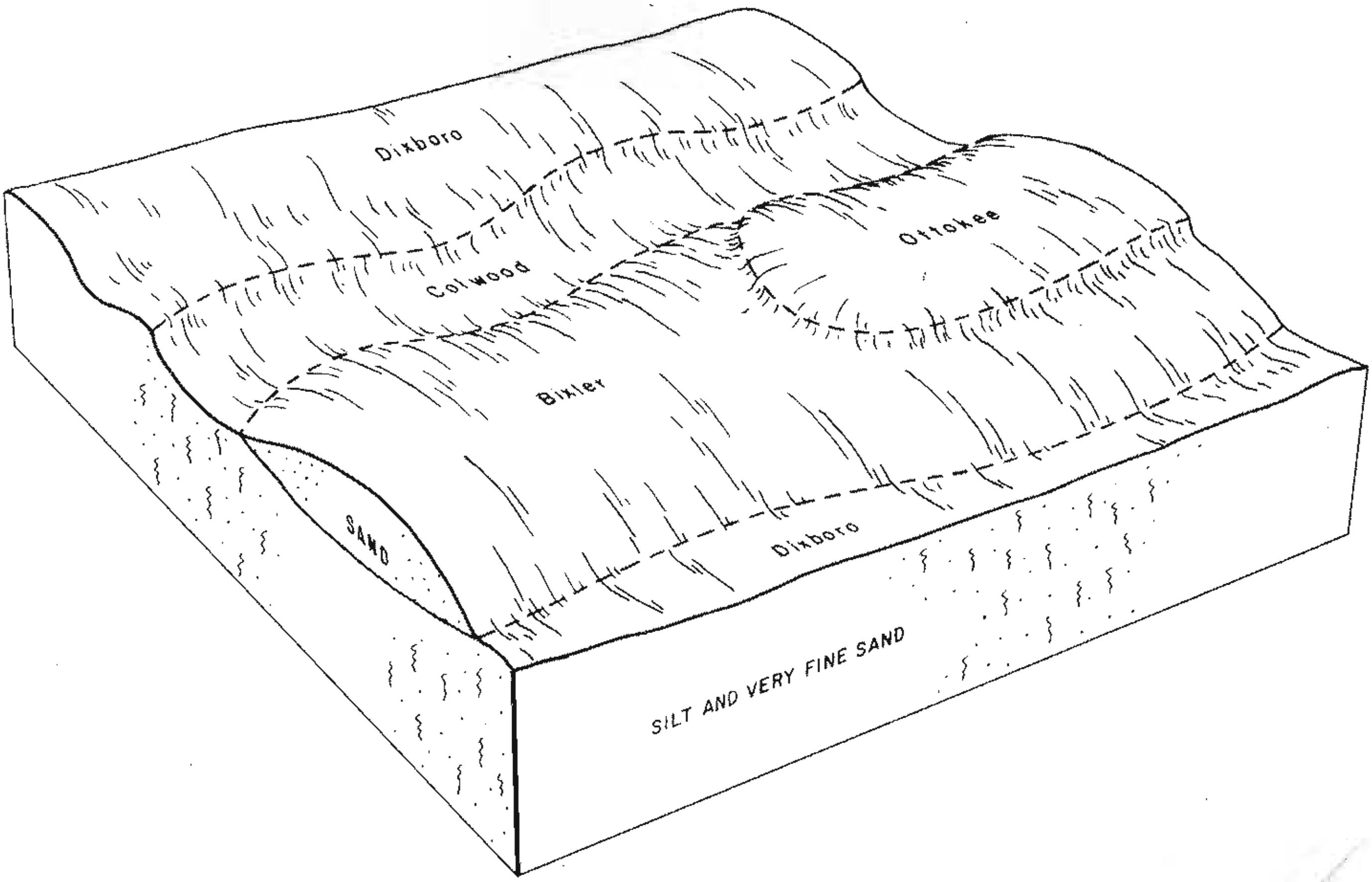


Figure 3.—Typical pattern of soils and parent material in the Bixler-Dixboro association.

and Rimer soils are somewhat poorly drained. Seward soils are moderately well drained and are on low rises.

Hoytville, Nappanee, and Mermill soils are limited for many uses because of the moderate to very slow permeability and the wetness caused by the seasonal high water table. If these soils are adequately drained, they are well suited to use as cropland. The main crops are corn, soybeans, and wheat. Tomatoes and sugar beets are the main specialty crops. The seasonal wetness and the moderate to very slow permeability are severe limitations to many engineering uses.

Areas dominated by level to gently sloping, loamy and sandy soils on lake plains

This group of associations makes up about 23 percent of the county. The soils are level to gently sloping and are very poorly drained and somewhat poorly drained. They formed in loamy, sandy, and clayey material on broad flats that have some slight rises or ridges. These soils are used mainly as cropland. In some areas they are in urban uses. The seasonal wetness is the main limitation to crops. It also is a limitation for building site development and sanitary facilities.

5. Bixler-Dixboro association

Nearly level and gently sloping, somewhat poorly drained soils that formed in loamy and sandy glacial lake sediment

The soils in this association are on broad, flat lake plains. They are mainly nearly level. Included in the association are some areas of more sloping soils on the side slopes adjacent to Swan Creek and the Ottawa and Maumee Rivers.

This association makes up about 6 percent of the county. It is about 30 percent Bixler soils, 25 percent Dixboro soils, and 45 percent minor soils (fig. 3). Bixler and Dixboro soils are somewhat poorly drained and are on narrow, irregular low rises and in broad, nearly level areas. These soils have moderate permeability and a seasonal water table within a depth of 1 or 2 feet.

The minor soils in this association are the Colwood, Gilford, Digby, Ottokee, Eel, Shoals, Sloan, and Sisson soils. The Colwood and Gilford soils are very poorly drained and are in drainageways. The Digby soils are somewhat poorly drained and are on low rises and low, irregular flats. The Ottokee soils are moderately well drained and are on sandy ridges. The Eel, Shoals, and Sloan soils are in small areas on narrow flood plains. The Sisson soils are well drained and are on the side slopes adjacent to major drainageways.

About 50 percent of the acreage of this association is used for houses, streets, parking lots, and other urban structures. Within city limits there are open areas where the soils have not been disturbed. These areas include parks, playgrounds, and yards.

These soils are limited for many engineering uses mainly because of the wetness caused by the seasonal high water table. If the Bixler soils are dry and do not have a vegetative cover, they are subject to wind erosion. If the subsoil of these soils is exposed, gullies can easily form. The walls of shallow excavations tend to collapse, especially when the soil is wet. The soils in this association have low potential for extensive recreation uses because of the seasonal wetness.

6. Colwood-Bixler association

Level to gently sloping, very poorly drained and somewhat poorly drained soils that formed in loamy and sandy glacial lake sediment

The soils in this association are on broad, flat lake plains, mainly near the rolling, sandy areas of the county. They are mainly level to gently sloping. Included in the association are some areas of more sloping soils on the side slopes adjacent to major drainageways.

This association makes up about 9 percent of the county. It is about 40 percent Colwood soils, 25 percent Bixler soils, and 35 percent minor soils.

Colwood soils are very poorly drained and are on broad, irregular flats and in poorly defined drainageways. Bixler soils are somewhat poorly drained and are on narrow, irregular ridges and on knolls. These soils have moderate to rapid permeability. The Bixler soils have a seasonal water table at a depth of 2 to 3 feet.

The minor soils in this association are the Lamson, Lenawee, Del Rey, Dixboro, Tedrow, Ottokee, Ceresco, and Sloan soils. The Lamson and Lenawee soils are very poorly drained and are in low areas. The Del Rey, Dixboro, and Tedrow soils are somewhat poorly drained, and the Ottokee soils are moderately well drained; these soils are on low rises. The Ceresco and Sloan soils are in small areas on flood plains.

The soils in this association are limited for many uses mainly because of the wetness caused by the seasonal high water table. Water ponds on the surface of Colwood soils during extended wet periods. If the Bixler soils are dry and do not have an adequate vegetative cover, they are subject to wind erosion.

The soils in this association are well suited to use as cropland. The main crops are corn, soybeans, and wheat. Potatoes, cabbage, and sweet corn are the main specialty crops.

The seasonal wetness is a severe limitation to many engineering uses.

7. Mermill-Metamora-Haskins association

Level or nearly level, very poorly drained and somewhat poorly drained soils that formed in loamy and clayey glacial lake deposits

The soils in this association are on broad, flat lake plains, mainly near the areas of reworked glacial till. They are mainly level or nearly level. Included in the association are some areas of more sloping soils on the side slopes adjacent to major drainageways.

This association makes up about 8 percent of the county. It is about 30 percent Mermill soils, 13 percent Metamora soils, 12 percent Haskins soils, and 45 percent minor soils.

Mermill soils are very poorly drained and are on broad, level flats and in poorly defined drainageways. Metamora and Haskins soils are somewhat poorly drained and are on narrow, irregular ridges and convex knolls. Mermill soils have a darker surface layer than Haskins soils. They are grayer throughout than Haskins and Metamora soils. Metamora soils have a darker surface layer and have more sand than Haskins soils.

The minor soils in this association are the Colwood, Gilford, Rimer, Seward, Shoals, and Sloan soils. The Colwood and Gilford soils are very poorly drained and are in low, flat areas. The Rimer soils are somewhat poorly drained, and the Seward soils are moderately well drained; these soils are more sandy than the major soils, and they are on small rises. The Shoals and Sloan soils are in small areas on narrow flood plains.

The major limitations to the use of the Mermill, Metamora, and Haskins soils are the very slow to moderately rapid permeability and the wetness caused by the seasonal high water table. If these soils are adequately drained, they are well suited to use as cropland. The main crops are corn, soybeans, and wheat. The major soils in this association are severely limited for many engineering uses because of the seasonal wetness and the restricted permeability in the substratum.

Areas dominated by level to gently sloping, sandy soils on lake beaches

This group of soils makes up about 29 percent of the county. The soils are level to gently sloping and are very poorly drained, somewhat poorly drained, or moderately well drained. They formed in sandy material of former lake beaches and are on broad irregular flats that have slight ridges and knolls. These soils are used mainly as cropland or woodland. The main limitations to crops are seasonal wetness and the hazard of wind erosion. Seasonal wetness also is a limitation to building site development and sanitary facilities.

8. Granby-Ottokee-Tedrow association

Level to gently sloping, very poorly drained, moderately well drained, and somewhat poorly drained soils that formed in sandy material

The soils in this association are sandy and are in broad, rolling areas. They are mainly level to gently sloping. Included in this association are some areas of more sloping soils on the higher sandy ridges and on the side slopes adjacent to major drainageways.

This association makes up about 29 percent of the county. It is about 30 percent Granby soils, 25 percent Ottokee soils, 15 percent Tedrow soils, and 30 percent minor soils (fig. 4).

Granby soils are very poorly drained and are on broad, irregular flats and in poorly defined drainageways. Ottokee soils are moderately well drained and are on narrow

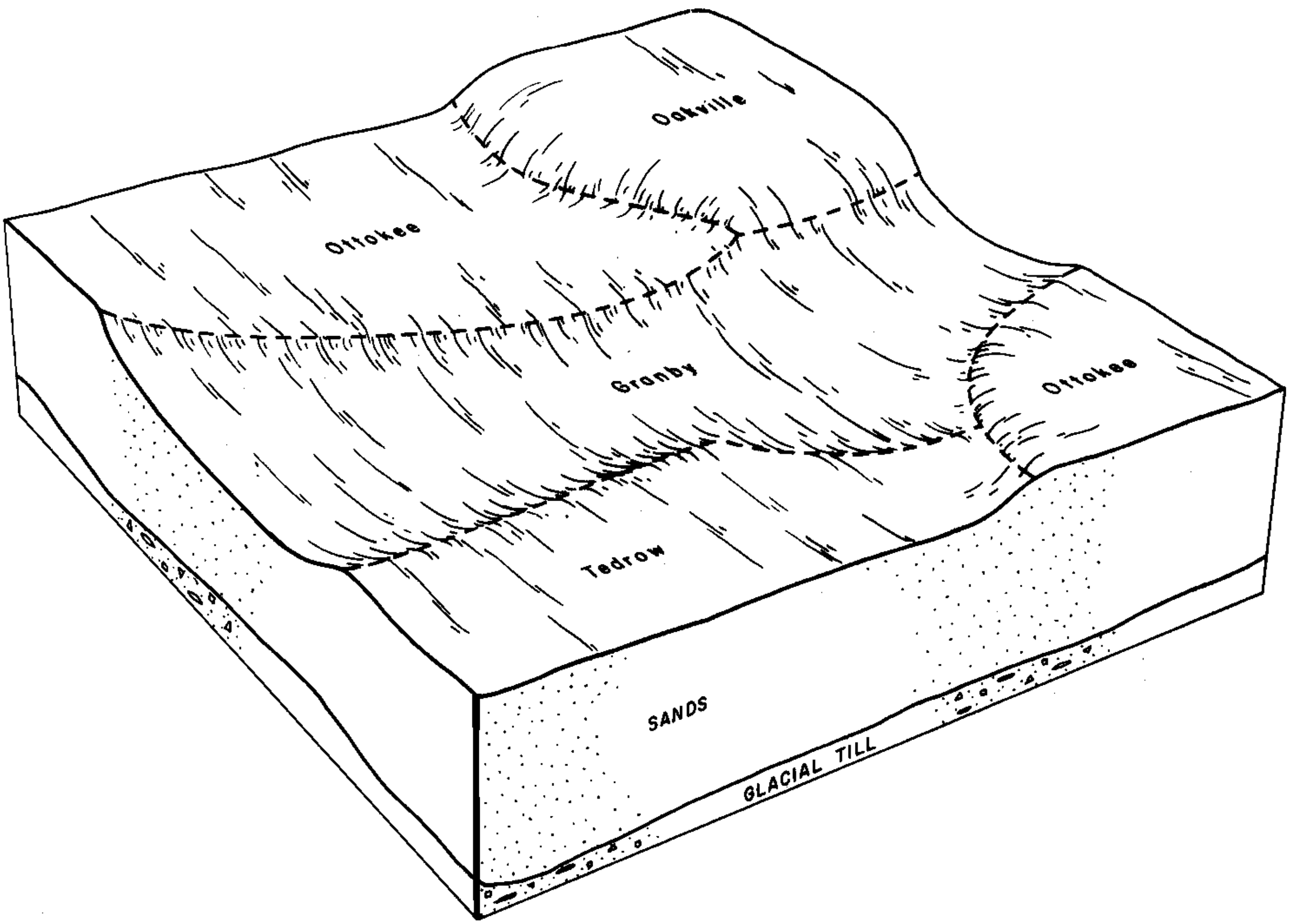


Figure 4.—Typical pattern of soils and parent material in the Granby-Ottokee-Tedrow association.

ridges and convex knolls. Tedrow soils are somewhat poorly drained and are on low rises and knolls. The soils in this association have rapid permeability. Granby and Tedrow soils have a seasonal water table near the surface. Ottokee soils have a seasonal water table within a depth of 1.5 to 3 feet.

The minor soils in this association are the Oakville, Sisson, Spinks, Ceresco, Eel, Shoals, Sloan, Colwood, Gilford, and Dunbridge soils and Udorthents. Also included are areas of Urban land. Oakville, Sisson, and Spinks soils are well drained and are on the higher ridges and on side slopes adjacent to Swan Creek and Ten Mile Creek. Ceresco, Eel, Shoals, and Sloan soils are in small areas on narrow flood plains. Colwood and Gilford soils are very poorly drained and are on low flats and in narrow drainageways. Dunbridge soils are in areas near limestone quarries. The areas of Urban land and Udorthents are mainly within city limits.

Granby and Tedrow soils are limited for many uses mainly because of wetness caused by the seasonal high water table. Unless the Granby soils are adequately drained, water ponds on the surface during extended wet periods. Ottokee soils are limited for many uses by wetness and by droughtiness during extended dry periods. When they are dry and do not have an adequate vegetative cover, Ottokee soils are subject to wind erosion.

The soils in this association are suited to use as cropland. The main crops are corn, soybeans, and wheat. These soils are limited for many engineering uses by wetness. The walls of shallow excavations tend to collapse, especially when the soil is wet. These soils have low potential for recreation uses because of the sandy texture of the surface layer and the seasonal wetness.

About 20 percent of the acreage of this association is used for houses, streets, parking lots, and other urban structures. Within city limits there are open areas where the soils have not been disturbed. These areas include parks, playgrounds, and yards.

Areas dominated by level or nearly level Urban land

This group makes up about 14 percent of the county. It consists of level or nearly level Urban land on broad flats. The soils in this group generally are limited by seasonal wetness, low soil strength, and high shrink-swell potential.

9. Urban land association

Level and nearly level urban areas

Urban land is in broad, flat areas within city limits. It is mainly level or nearly level. In some areas there are steep slopes. Included in the association are some areas of sloping soils on the side slopes adjacent to rivers and creeks.

This association makes up about 14 percent of the county. It is about 60 percent Urban land and 40 percent minor soils.

Urban land is used for houses, office buildings, streets, parking lots, and other urban structures.

The minor soils in this association are the Bixler, Del Rey, Dixboro, St. Clair, Sisson, Lenawee, Colwood, Toledo, and Muskego soils and Udorthents. The Bixler, Del Rey, and Dixboro soils are somewhat poorly drained and are on low ridges and broad, irregular flats. The St. Clair soils are moderately well drained, and the Sisson soils are well drained; these soils are on side slopes adjacent to Swan Creek and the Ottawa and Maumee Rivers. The Lenawee, Colwood, and Toledo soils are very poorly drained and are on broad flats and in poorly defined drainageways. The Muskego soils are very poorly drained and are in small, low-lying areas. The areas of Udorthents, which consist of cut and fill land, are along the river.

More than 50 percent of the acreage of this association is used for buildings, streets, parking lots, railroad yards, and gas and oil storage. Open areas where the soil has not been disturbed include parks, playgrounds, and yards.

Wetness caused by the seasonal high water table and the unstable nature of the soil material are the main limitations to many engineering uses. Flooding is a hazard along Swan Creek and the Maumee and Ottawa Rivers.

Soil maps for detailed planning

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

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

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Digby sandy loam, 0 to 2 percent slopes, is one of several phases in the Digby series.

Some map units are made up of two or more major soils, for example, a soil complex. A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Digby-Urban land complex, 0 to 3 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

Soil descriptions

BxA—Bixler loamy fine sand, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil on outwash plains, beach ridges, and deltas. The areas on low ridges are long and narrow, and those on low knolls are oval shaped. The areas range from 2 to 25 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 10 inches thick. The subsurface layer, which extends to a depth of about 28 inches, is mottled, dark yellowish brown and brown fine sand. The subsoil extends to a depth of about 45 inches. It is mottled, light brownish gray, friable fine sandy loam in the upper part and mottled, grayish brown and yellowish brown, friable and firm silt loam in the lower part. The substratum, to a depth of about 72 inches, is mottled, gray stratified silty and sandy material.

Included in mapping are small areas of Tedrow and Ottokee soils, which are sandy throughout. Also included are areas of the very poorly drained Lamson and Colwood soils in low spots and drainageways. These included soils make up about 20 percent of this map unit.

Runoff is slow. Permeability is rapid in the upper layers of sandy material and moderate in the lower part of the subsoil and in the substratum. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is slightly acid to neutral in the upper part and neutral in the lower part. This soil has a seasonal high water table.

In most areas, this soil is used as cropland, for which it has medium potential (fig. 5). Potatoes and other truck crops are grown in areas where the drainage of this soil has been improved. This soil has medium potential for use as woodland. It has low potential for building site development and sanitary facilities and medium potential for recreation uses and for the development of habitat for wetland wildlife.

This soil is suited to crops and to use as pasture. If this soil is used for crops or as pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is bare of vegetation. If this soil is used as pasture, grazing should be restricted when the soil is wet to prevent damage to plants and to avoid soil compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness. Seedling mortality and plant competition are the main concerns in managing woodland.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Onsite investigations will be necessary to determine the availability of outlets. Local roads and streets are subject to damage by frost action. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness and the sandy texture of the surface layer are limitations to many recreation uses.

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

BxB—Bixler loamy fine sand, 2 to 6 percent slopes. This is a gently sloping, somewhat poorly drained soil on outwash plains, beach ridges, and deltas. It is on long narrow ridges or low knolls. The areas range from 2 to 20 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsurface layer, which extends to a depth of 25 inches, is mottled, yellowish brown fine sand. The subsoil extends to a depth of about 43 inches. It is mottled, yellowish brown and grayish brown, firm fine sandy loam and silt loam. The substratum, to a depth of about 72 inches, is stratified, yellowish brown and gray silt loam.

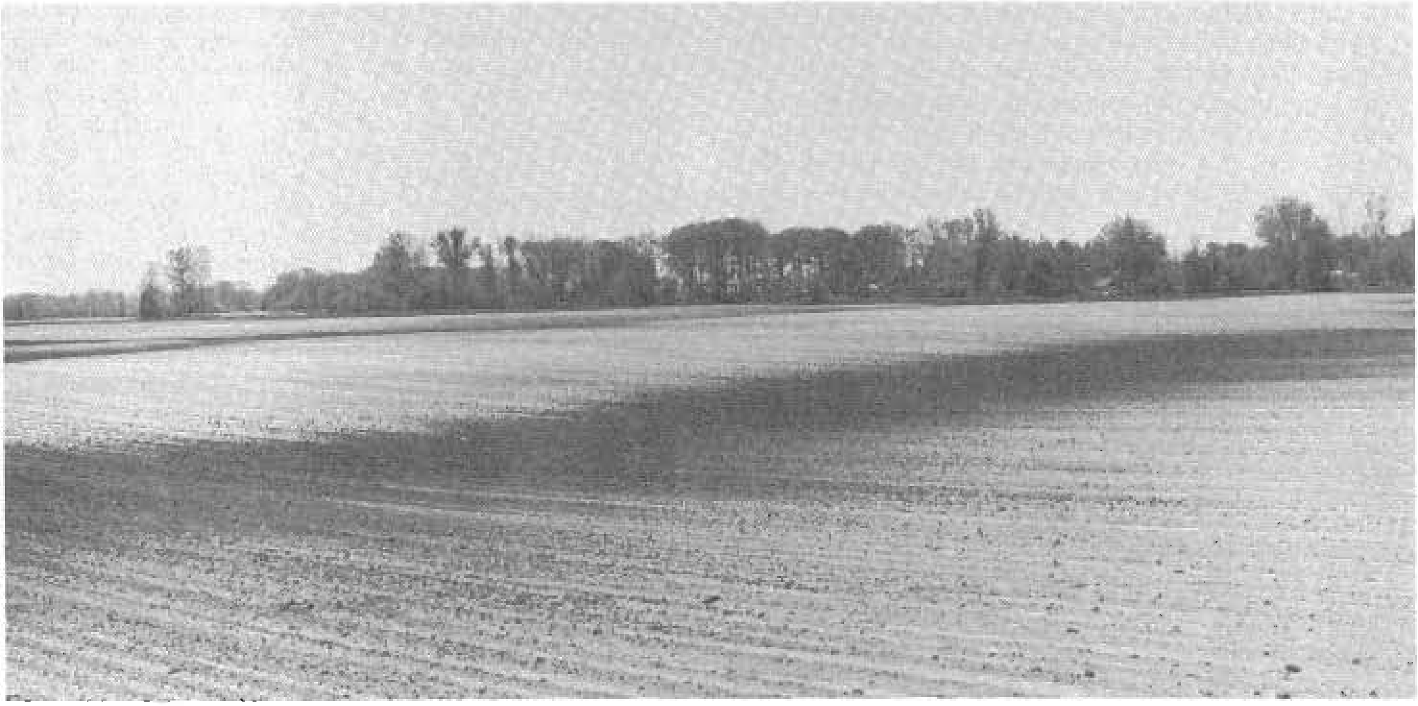


Figure 5.—The light-colored soil on this landscape is Bixler loamy fine sand, and the dark-colored is Colwood loam. These soils are suitable for farming.

Included in mapping are small areas of Ottokee and Tedrow soils, which are sandy throughout. Also included are areas of less sloping soils and areas of Colwood and Lamson soils in some drainageways and low spots. These included soils make up about 20 percent of this map unit.

Runoff is slow. Permeability is rapid in the upper layers of sandy material and moderate in the lower part of the subsoil and in the substratum. The root zone is deep, and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is slightly acid to neutral in the upper part and neutral in the lower part. This soil has a seasonal high water table.

In most areas, this soil is used as cropland, for which it has medium potential. Potatoes and other truck crops are grown in some areas. This soil has medium potential for use as woodland. It has medium potential for recreation uses and for building site development and sanitary facilities.

This soil is suited to crops and to use as pasture. Controlling erosion is the main concern of management. Conservation tillage, winter cover crops, and crop residue help to prevent excessive soil loss. A subsurface drainage system can be used to lower the water table in the less sloping areas. Wind erosion is a hazard if this soil is bare of vegetation. If this soil is used as pasture, grazing should be restricted when the soil is wet to prevent damage to plants and to avoid surface compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness and some droughtiness. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by the seasonal wetness. If outlets are available, the water table can be lowered through subsurface drainage. Onsite investigations will be necessary to determine the availability of outlets. The sandy texture of the surface layer is a limitation to many recreation uses.

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

ByA—Bixler-Urban land complex, 0 to 3 percent slopes. This map unit consists of a nearly level, somewhat poorly drained Bixler soil and areas of Urban land. It is in broad areas on flats and narrow, elongated areas on low ridges. The areas of this map unit range from 2 to 115 acres. This unit is about 50 percent Bixler soil and 35 percent Urban land. The Bixler soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Bixler soil is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer, which extends to a depth of about 26 inches, is mottled, dark yellowish brown and brown fine sand. The subsoil extends to a depth of about 43 inches. It is mottled, light brownish gray and grayish brown, friable fine sandy loam and silt loam. The substratum, to a depth of about 72 inches, is stratified yellowish brown and gray silt loam. In some areas, this soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, buildings, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of Colwood, Lamson, and Ottokee soils. Colwood and Lamson soils are very poorly drained and are in low, wet areas or drainageways. Ottokee soils are moderately well drained and are on the slightly higher ridges and knolls.

In most areas, the soils in this map unit have been artificially drained. Where the Bixler soil has not been drained, the water table is near the surface during extended wet periods. Permeability is rapid in the surface layer and the upper part of the subsoil and moderate in the lower part of the subsoil and in the substratum. The organic matter content is moderately low. The subsoil is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part.

The Bixler soil is used for parks, open spaces, lawns, and gardens. It has medium potential for lawns, vegetables, flower gardens, trees, and shrubs. It has low to medium potential for recreation uses.

This soil is suited to grasses, flowers, and vegetables. If it is drained, this soil is well suited to trees and shrubs. If outlets are available, subsurface drainage can be used to remove excess water from the soil. Water-tolerant plants should be selected for planting. Water erosion is not a major hazard unless the soil is bare of vegetation. Wind erosion is a hazard if the soil is dry and bare of vegetation.

The Bixler soil is limited for building site development and playgrounds by wetness. If this soil is used as a site for buildings or playgrounds, it should be artificially drained. This soil is better suited to buildings that do not have a basement than to those that do. This soil is limited for sanitary facilities by wetness. If this soil is used for local streets and roads or for parking lots, artificial drainage and suitable base material are needed. The walls of shallow excavations tend to collapse, especially when the soil is wet.

The Bixler soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

Ce—Ceresco sandy loam, occasionally flooded. This is a nearly level, somewhat poorly drained soil on flood plains. It is in long, narrow areas and on knolls. The areas range from 2 to 10 acres.

Typically, the surface layer is very dark gray sandy loam about 11 inches thick. The subsoil extends to a depth of about 36 inches. It is mottled, dark brown, friable sandy loam in the upper part and mottled, grayish brown, firm sandy loam in the lower part. The substratum, to a depth of about 60 inches, is grayish brown sandy loam that has thin strata of sand and loamy sand. In places, the surface layer is fine sandy loam.

Included in mapping are small areas of Sloan soils in drainageways. Also included are areas of better drained soils on slight rises along stream channels and some small areas of Shoals soils. These included soils make up about 20 percent of this map unit.

Runoff is slow. Permeability is moderate or moderately rapid. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderate. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. The seasonal water table is at a depth of about 1 foot.

In most areas, this soil is used as cropland and woodland. It has high potential for these uses. It has low potential for building site development and sanitary facilities and medium potential for recreation uses.

This soil is suited to crops and to use as pasture. Soil wetness and the hazard of occasional flooding are the main concerns in managing cropland and pasture on this soil. In some years, wetness can delay the harvesting of crops. If outlets are available, a subsurface drainage system can be used to lower the water table. Floods that occur in winter and spring commonly restrict tillage and planting operations in spring. Because floods are less common and of shorter duration during the growing season, crops such as corn and soybeans generally can be grown without damage. If this soil is used as pasture, grazing should be restricted during wet periods to prevent excessive soil compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is flooded. Plant competition from seedlings and shrubs is a limitation in areas where new plantings are made.

This soil is limited for building site development and sanitary facilities by the seasonal wetness and the hazard of flooding. Local roads and streets are subject to damage by frost action and flooding. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Flooding and wetness are limitations to many recreation uses.

The capability subclass is IIIw; the woodland suitability subclass is 2o.

Co—Colwood loam. This is a level and nearly level, very poorly drained soil on outwash plains and deltas. It is in low, slight depressions and on broad flats. The areas range from 2 to 80 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is black loam about 12 inches thick. The subsoil extends to a depth of about 45 inches. It is mottled, dark gray, friable loam in the upper part and mottled, grayish brown loam and sandy clay loam in the lower part. The substratum, to a depth of about 60 inches, is gray and dark brown stratified silt loam and fine sand.

Included in mapping are small areas of Dixboro soils on small knolls. Also included are areas of Lamson soils, which have more sand in the subsoil than Colwood soils. These included soils make up about 20 percent of this map unit.

Runoff is slow or ponded. Permeability is moderate. The root zone is deep, and the available water capacity is high. The organic matter content is high. The subsoil is neutral or mildly alkaline. The water table is at or near the surface during extended wet periods.

In most areas, this soil is used as cropland. It has high potential for use as cropland and woodland. This soil has low potential for building site development and sanitary facilities and for most recreation uses.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. Ponding can damage wheat. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of cover crops and crop residue helps to control erosion and to maintain the organic matter content. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet. Plant competition is a limitation to woodland productivity.

This soil is limited for building site development and sanitary facilities mainly by the seasonal high water table. Local roads and streets and parking lots are subject to damage by frost action.

The capability subclass is IIw; the woodland suitability subclass is 3w.

Cp—Colwood-Urban land complex. This map unit consists of a level and nearly level, very poorly drained Colwood soil and areas of Urban land. It is in elongated and broad areas on flats that have been developed for residential and commercial use. The areas of this map unit range from 5 to 80 acres. This unit is about 55 percent Colwood loam and 30 percent Urban land. The Colwood soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Colwood soil is black loam about 12 inches thick. The subsoil extends to a depth of about 45 inches. It is mottled, dark gray, friable loam in the upper part and mottled, grayish brown, friable loam and sandy clay loam in the lower part. The substratum, to a depth of about 60 inches, is gray and dark brown silt loam and fine sand. In places, this soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, buildings, and other structures have altered or obscured the soil so that identification is not feasible.

Included in mapping and making up about 15 percent of this unit are small areas of Dixboro and Bixler soils.

In most areas, the soils in this map unit have been artificially drained. Where the Colwood soil has not been drained, the water table is at the surface during extended wet periods. Some areas are frequently ponded by runoff from adjacent higher areas and from urban structures. Permeability is moderate. The organic matter content is high. The subsoil is neutral to mildly alkaline.

The Colwood soil is used for parks, open spaces, lawns, and gardens. It has high potential for lawns, vegetables, flower gardens, trees, and shrubs. It has low potential for some recreation uses.

If the Colwood soil is adequately drained, it is well suited to grasses, flowers, vegetables, trees, and shrubs. If outlets are available, subsurface drains can be used to remove excess water from the soil. Trees, shrubs, and other perennial plants selected for planting should be tolerant of soil wetness. Water erosion generally is not a hazard unless the soil is bare of vegetation. Wind erosion is a hazard if the soil is dry and bare of vegetation.

The Colwood soil is limited for building site development by soil wetness, frost action, and low soil strength. If this soil is used as a site for buildings, it should be artificially drained. This soil is better suited to buildings that do not have a basement than to those that do. This soil has severe limitations for sanitary facilities. If this soil is used for local roads and streets and parking lots, drainage should be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet.

The Colwood soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

DdA—Del Rey loam, 0 to 3 percent slopes. This is a nearly level, deep, somewhat poorly drained soil mainly on deltas and outwash plains. The areas on low ridges are long and narrow, and those on low knolls are oval shaped. The areas range from 4 to 30 acres.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil extends to a depth of about 34 inches. It is mottled, yellowish brown, firm clay loam in the upper part and mottled, brown and grayish brown, firm silty clay and silty clay loam in the lower part. The substratum, to a depth of about 60 inches, is dark grayish brown, stratified silt loam.

Included in mapping are small areas of the very poorly drained Lenawee soils in drainageways and slight depressions. The somewhat poorly drained Haskins soils are included in areas where loamy material has been deposited over the finer textured material. Also included are areas of the better drained Sisson soils. These included soils make up about 20 percent of this map unit.

Runoff is slow. Permeability is moderate in the surface layer and slow in the subsoil and substratum. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is slightly acid to neutral. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland. The main crops are corn, soybeans, and small grains. Specialty crops are grown where the drainage of this soil has been improved. This soil has high potential for use as cropland. It has low potential for building site development and sanitary facilities and for most recreation uses.

If this soil is used as cropland, wetness is a moderate limitation. A subsurface drainage system commonly is effective in improving drainage. In most areas, this soil has been drained. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration.

If this soil is used as pasture, grazing should be restricted during wet periods to prevent excessive soil compaction.

This soil is well suited to trees. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by the seasonal high water table (fig. 6). Building sites should be graded so that surface water is drained away from the building foundation. The shrinking and swelling in the subsoil is a limitation for houses that have a basement. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 3o.

DeA—Del Rey loam, sandy substratum, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil mainly on outwash plains and deltas. It is on slight rises and broad flats. The areas range from 4 to 70 acres.

Figure 6.—In this area, Del Rey loam is used for residential development. This soil has a seasonal high water table, which is a limitation to use as building sites; however, this limitation can be overcome through artificial drainage.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of about 40 inches. It is mottled, yellowish brown and brown, firm clay loam and silty clay loam in the upper part and mottled, brown and grayish brown, firm silty clay and silty clay loam in the lower part. The substratum, to a depth of about 60 inches, is light gray and dark yellowish brown sand.

Included in mapping are small areas of Haskins soils, which have more sand in the upper part of the subsoil than this Del Rey soil. Also included are Mermill and Lenawee soils in drainageways and low spots and small areas of more sloping soils. These included soils make up about 20 percent of this map unit.

Runoff is slow. Permeability is slow in the subsoil and rapid in the substratum. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is slightly acid to neutral. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland, for which it has high potential. This soil has medium potential for use as woodland, for recreation uses, and for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if the soil is bare of vegetation. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities because of the seasonal high water table and the unstable substratum material. It is better suited to buildings that do not have a basement than to those that do. Limitations to buildings that have a basement are the shrinking and swelling in the subsoil and the wetness of the substratum material. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse. Wetness is a moderate limitation to recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 3o.

DcA—Del Rey-Urban land complex, 0 to 3 percent slopes. This map unit consists of a nearly level, somewhat poorly drained Del Rey soil and areas of Urban land. It is in broad areas on flats and in narrow, elongated areas on low ridges. The areas range from 5 to 200 acres. This map unit is about 50 percent Del Rey loam and 40 percent Urban land. The Del Rey soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Del Rey soil is dark grayish brown loam about 8 inches thick. The subsoil extends to a depth of about 32 inches. It is mottled, yellowish brown and brown, firm clay loam and silty clay loam in the upper part and mottled, brown and grayish brown, firm silty clay and silty clay loam in the lower part. The substratum, to a depth of about 60 inches, is grayish brown, stratified silt loam. In places, this soil has been altered by cutting and filling during construction.

Urban land consist of areas where streets, parking lots, buildings, and other structures have obscured or altered the soil so that identification is not feasible.

Included in mapping and making up about 15 percent of this unit are small areas of the very poorly drained Lenawee and Mermill soils in drainageways and low spots. Also included are small areas of Haskins and Dixboro soils.

In most areas, the soils in this map unit have been artificially drained. Where the Del Rey soil has not been drained, the water table is near the surface during extended wet periods. Permeability is moderate in the surface layer and slow in the subsoil and substratum. The organic matter content is moderately low. The subsoil is slightly acid to neutral in the upper part and slightly acid to moderately alkaline in the lower part.

The Del Rey soil is used for parks, open spaces, lawns, and gardens. It has high potential for lawns, vegetables, flower gardens, trees, and shrubs. It has medium potential for recreation uses.

If the Del Rey soil is drained, it is well suited to grasses, flowers, vegetables, trees, and shrubs. Trees, shrubs, and other perennial plants selected for planting should be tolerant of wetness. Erosion generally is not a hazard unless the soil is bare of vegetation. This soil is more susceptible to erosion in areas where slopes are steeper.

The Del Rey soil is limited for building site development by the seasonal wetness. If this soil is used as a site for buildings, it should be artificially drained. This soil is better suited to buildings that do not have a basement than to those that do. If this soil is used for local streets and roads or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse because of wetness. This soil is poorly suited to use as septic tank absorption fields.

The Del Rey soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

DgA—Digby sandy loam, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil mainly on outwash plains, terraces, and beach ridges. The areas on low ridges are long and narrow, and those on low knolls are oval shaped. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. It is mottled, brown, grayish brown, and light brownish gray, firm and friable loam, sandy clay loam, and sandy loam to a depth of 21 inches and mottled, yellowish brown and light brownish gray, firm and friable sandy clay loam and sandy loam below that. The substratum, to a depth of about 60 inches, is gray and grayish brown loamy sand, sandy loam, and sand. In some areas, the surface layer is somewhat darker than is typical.

Included in mapping are small areas of the sandy Tedrow soils and small areas of Dixboro soils, which formed in stratified silt loam and very fine sand. Also included are areas of the very poorly drained Colwood soils in low areas and drainageways. These included soils make up about 15 percent of this map unit.

Runoff is slow. Permeability is moderate in the surface layer and subsoil and rapid in the substratum. The organic matter content is moderately low. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The subsoil is strongly acid in the upper part and medium acid to neutral in the lower part. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland and for recreational development. It has high potential for use as cropland and woodland. This soil has low potential for building site development and sanitary facilities. It has medium potential for recreation uses and for the development of habitat for wetland wildlife.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. Water erosion is a hazard in the more sloping areas. Wind erosion is a hazard if the soil is dry and bare of vegetation. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce soil compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to recreation uses.

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

DgB—Digby sandy loam, 2 to 6 percent slopes. This is a gently sloping, somewhat poorly drained soil on outwash plains, terraces, and beach ridges. The areas on ridges are long and narrow, and those on low knolls are oval shaped. The areas from 2 to 10 acres.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. It is mottled, brown, grayish brown, and light brownish gray, firm loam, sandy clay loam, and sandy loam in the upper part and yellowish brown and light brownish gray sandy clay loam and sandy loam in the lower part. The substratum, to a depth of about 60 inches, is gray and grayish brown loamy sand, sandy loam, and sand.

Included in mapping are small areas of the sandy Tedrow and Ottokee soils and small areas of Dixboro soils, which formed in stratified silt loam and very fine sand. Also included are areas of the very poorly drained Colwood soils in low areas and drainageways. The included soils make up about 15 percent of this map unit.

Runoff is medium. Permeability is moderate in the surface layer and subsoil and rapid in the substratum. The root zone is deep, and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is strongly acid in the upper part and medium acid to neutral in the lower part. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland. It has high potential for use as cropland and woodland. This soil has medium potential for building site development, sanitary facilities, and recreation uses.

This soil is well suited to crops and to use as pasture. Controlling erosion is the main concern of management. Conservation tillage, cover crops, crop residue, and grassed waterways can reduce erosion. Improving drainage is another management concern. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is bare of vegetation. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce soil compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage by frost action. If this soil is used for local roads and streets, drainage should be improved and a suitable base material used.

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

DoA—Digby-Urban land complex, 0 to 3 percent slopes. This map unit consists of a nearly level, somewhat poorly drained Digby soil and areas of Urban land. It is in broad areas on flats and in narrow, elongated areas on low ridges. The areas range from 10 to 60 acres. This map unit is about 45 percent Digby sandy loam and about 40 percent Urban land. The Digby soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Digby soil is dark grayish brown sandy loam about 8 inches thick. The subsoil extends to a depth of about 40 inches. It is mottled, brown, grayish brown, and light brownish gray, friable and firm loam, sandy clay loam, and sandy loam to a depth of 21 inches and mottled, yellowish brown and light brownish gray, firm sandy clay loam and sandy loam below that. The substratum, to a depth of about 60 inches, is gray and grayish brown loamy sand, sandy loam, and sand.

Urban land consists of areas where streets, parking lots, buildings, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of the very poorly drained Colwood and Mermill soils in drainageways and low spots. Also included are small areas of Haskins and Dixboro soils.

In most areas, the soils in this map unit have been artificially drained. Where the Digby soil has not been drained, the water table is near the surface during extended wet periods. Permeability is moderate in the surface layer and subsoil and rapid in the substratum. The organic matter content is moderately low. The subsoil is slightly acid to very strongly acid in the upper part and slightly acid to mildly alkaline in the lower part.

The Digby soil is used for parks, open spaces, lawns, and gardens. It has medium potential for lawns, vegetables, and flower gardens and high potential for trees and shrubs. It has medium potential for recreation uses.

If the Digby soil is drained, it is well suited to grasses, flowers, vegetables, trees, and shrubs. A subsurface drainage system is the most effective for draining excess water from the soil. Water-tolerant perennial plants should be selected for planting. Soil erosion generally is not a hazard unless the soil is bare of vegetation.

The Digby soil is limited for building site development by the seasonal wetness. If this soil is used as a building site, drainage needs to be improved. This soil is better suited to buildings that do not have a basement than to those that do. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet. This soil is limited by wetness for use as septic tank absorption fields.

The Digby soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

DsA—Dixboro fine sandy loam, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil on outwash plains and deltas. It is in long, narrow areas on low ridges and in oval areas on low knolls. The areas range from 2 to 10 acres.

Typically, the surface layer is very dark gray fine sandy loam about 9 inches thick. The subsurface layer is mottled, grayish brown, very friable fine sandy loam about 7 inches thick. The subsoil extends to a depth of about 27 inches. It is mottled, brown and yellowish brown, friable fine sandy loam. The substratum, to a depth of about 60 inches, is grayish brown, stratified fine sand and silt loam.

Included in mapping are small areas of Colwood and Lamson soils in drainageways and low, wet spots. Bixler soils are included in areas where there is more sand. These included soils make up about 25 percent of this map unit.

Runoff is slow. Permeability is moderate. Where this soil has been drained, the root zone is deep and the available water capacity is high. The organic matter content is moderate. The subsoil is neutral to mildly alkaline. The water table is directly below the surface during extended wet periods.

In most areas, this soil is used as cropland. It has high potential for use as cropland and woodland. This soil has low potential for building site development and sanitary facilities and medium potential for recreation uses and for the development of habitat for wetland wildlife.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and to prevent damage to plants.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, subsurface drainage can be used to lower the water table. Building sites should be graded so that surface water is drained away from the building foundation. The unstable substratum material is a limitation to houses that have a basement. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to recreation uses.

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

DtA—Dixboro-Urban land complex, 0 to 2 percent slopes. This map unit consists of a nearly level, somewhat poorly drained Dixboro soil and areas of Urban land. It is in broad areas on flats and in narrow, elongated areas on low ridges. The areas range from 5 to 80 acres. This map unit is about 55 percent Dixboro fine sandy loam and about 30 percent Urban land. The Dixboro soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Dixboro soil is very dark gray fine sandy loam about 9 inches thick. The subsurface layer is mottled, grayish brown, very friable fine sandy loam about 7 inches thick. The subsoil extends to a depth of about 27 inches. It is mottled, brown and yellowish brown, friable fine sandy loam. The substratum, to a depth of about 60 inches, is mottled, grayish brown, friable fine sand and silt loam. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, buildings, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 25 percent of this unit are small areas of Colwood, Del Rey, and Lenawee soils. The very poorly drained Colwood and Lenawee soils are in low, wet areas and drainageways. Del Rey soils have more clay in the subsoil than the Dixboro soil.

In most areas, the soils in this map unit have been artificially drained. Where the Dixboro soil has not been drained, the water table is near the surface during extended wet periods. Permeability is moderate. The organic matter content is moderate. The subsoil is medium acid to mildly alkaline.

The Dixboro soil is used for parks, open spaces, lawns, and gardens. It has high potential for lawns, vegetables, flower gardens, trees, and shrubs. It has medium potential for recreation uses.

If the Dixboro soil is drained, it is well suited to grasses, flowers, vegetables, trees, and shrubs. If outlets are available, a subsurface drainage system is the most effective for draining excess water from the soil. Water-tolerant perennial plants should be selected for planting. Water erosion generally is not a hazard unless the soil is bare of vegetation. The subsoil material erodes easily; where the subsoil is exposed, rivulets will form during a rainstorm. Wind erosion is a hazard if this soil is dry and bare of vegetation.

The Dixboro soil is limited for building site development because of wetness, frost action, and low soil strength. It is better suited to buildings that do not have a basement than to those that do. The walls of shallow excavations tend to collapse, especially when the soil is wet. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The Dixboro soil is limited by wetness for use as septic tank absorption fields.

The Dixboro soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

DuB—Dunbridge sandy loam, 0 to 4 percent slopes. This is a nearly level to gently sloping, moderately deep, well drained soil. It is in narrow, elongated areas on low ridges and on low knolls. The areas range from 2 to 15 acres. They commonly are near quarries.

Typically, the surface layer is very dark grayish brown, friable sandy loam about 8 inches thick. The subsoil extends to a depth of about 25 inches. It is dark brown, friable sandy loam in the upper part and reddish brown, firm, gravelly sandy clay loam in the lower part. The layer below that is light gray, weathered and fractured limestone about 2 inches thick. It is underlain, at a depth of about 27 inches, by solid limestone bedrock.

Included in mapping are small areas where the soil is less than 20 inches deep to bedrock and areas where it is more than 40 inches deep to bedrock. Also included are small areas of Rimer and Seward soils. The included soils make up about 20 percent of this unit.

Runoff is medium. Permeability is rapid, and the available water capacity is low. The organic matter content is moderate. The subsoil is neutral to mildly alkaline.

In most areas, this soil has been cleared of trees and is used as cropland or as sites for houses. This soil has medium potential for use as cropland, pasture, and woodland. It has high potential for most recreation uses; however, in some areas bedrock hinders the leveling and grading necessary for large playgrounds.

Droughtiness is the main concern in cropland management. If this soil is used for crops, erosion is a hazard, especially on the steeper slopes. Conservation tillage and cover crops help to reduce erosion. The fertility and organic matter content of this soil need to be maintained or improved. Returning crop residue or other organic material to the soil helps to stabilize the surface layer, improve fertility, and increase the infiltration and retention of water. Drainage generally is adequate for crops.

This soil is not commonly used as permanent pasture; however, it can support a variety of pasture grasses.

This soil is moderately well suited to trees. In a few small areas, it is still in woodland. The trees selected for planting should be tolerant of droughtiness.

This soil is limited for building site development and sanitary facilities by the moderate depth to bedrock. Bedrock can hinder the construction of local streets, road grading, and ditching.

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

Ee—Eel loam, occasionally flooded. This is a nearly level, moderately well drained soil on flood plains. It is in elongated, narrow areas and small convex areas along the major creeks and rivers. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of about 31 inches. It is mottled, dark brown and yellowish brown, friable loam in the upper part and mottled, dark yellowish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is mottled, dark brown sandy loam that has thin strata of loamy sand. In some areas, the surface layer has more sand than is typical, and in others it is very dark grayish brown.

Included in mapping are areas of Shoals and Sloan soils in ponded areas and drainageways. Also included are some soils on slightly higher ridges. These included soils make up about 20 percent of this unit.

Runoff is slow. Permeability is moderate, and the available water capacity is high. The root zone is deep. The organic matter content is moderate. The subsoil is neutral. The water table is at a depth of about 3 feet during extended wet periods. This soil is subject to occasional flooding.

In most areas, this soil is used as cropland and woodland. It has high potential for these uses. The main crops are corn and soybeans. This soil has low potential for building site development, sanitary facilities, and many recreation uses.

This soil is well suited to crops and to use as pasture. The hazard of flooding is the main concern of management. Wetness also is a limitation. Wheat can be damaged by flooding. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness.

This soil is limited for building site development and sanitary facilities by the hazard of flooding and the seasonal wetness. Local roads and streets are subject to damage caused by flooding and wetness. If this soil is used for local roads and streets, drainage should be improved and a suitable base material used. Flooding is a limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 1o.

FuA—Fulton silty clay loam, 0 to 2 percent slopes. This is a nearly level, somewhat poorly drained soil on the lake plain. It is on slight rises and in broad areas on flats. The areas range from 2 to 25 acres.

Typically, the surface layer is dark grayish brown silty clay loam about 9 inches thick. The subsoil extends to a depth of about 39 inches. It is mottled, gray, very firm silty clay in the upper part and mottled, brown, yellowish brown, and gray, very firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, yellowish brown, very firm silty clay.

Included in mapping are the very poorly drained Toledo and Latty soils in narrow drainageways and low spots. Also included are areas where the surface layer is loam and small areas where slopes are more than 2 percent. The included soils make up 5 to 15 percent of this map unit.

Runoff is slow. Permeability is very slow, and the available water capacity is moderate. The root zone is deep. The organic matter content is moderately low. The subsoil is slightly acid to mildly alkaline. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland, for which it has medium or high potential. The main crops are corn, soybeans, and small grains. In areas where drainage has been improved, this soil is used for specialty crops. This soil has low potential for building site development and sanitary facilities. It has medium or low potential for most recreation uses.

This soil is suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. The surface tends to crust after a heavy rain, and this can hinder seedling emergence. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration. If this soil is used as pasture, grazing should be restricted when the soil is wet to help reduce surface compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, a subsurface drainage system can be used to lower the water table. Building sites should be graded so that surface water is drained away from the building foundation. The shrinking and swelling in the subsoil is a limitation for houses that have a basement. Local roads and streets are subject to damage resulting from the low soil strength and the shrinking and swelling in the subsoil. If this soil is used for local roads and streets, drainage should be improved and a suitable base material used. Wetness is a limitation to recreation uses.

The capability subclass is IIIw; the woodland suitability subclass is 3c.

FuB—Fulton silty clay loam, 2 to 6 percent slopes. This is a gently sloping, somewhat poorly drained soil on the lake plain. It is in elongated, narrow areas adjacent to drainageways and on low rises and knolls. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil extends to a depth of about 32 inches. It is gray, mottled, very firm silty clay in the upper part and mottled, brown, yellowish brown, and gray, very firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, yellowish brown, very firm silty clay. In some of the steeper areas of this unit, the soil is moderately eroded, and the surface layer has more clay than is typical.

Included in mapping are the very poorly drained Toledo and Latty soils in narrow drainageways. Also included are areas where the surface layer is loam. In some small areas, this soil has slopes of less than 2 percent or more than 6 percent. The included soils make up about 20 percent of this map unit.

Runoff is medium. Permeability is very slow, and the available water capacity is moderate. The root zone is deep. The organic matter content is moderately low. The subsoil is slightly acid to mildly alkaline. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland, for which it has medium or high potential. The main crops are corn, soybeans, and small grains. In areas where drainage has been improved, this soil is used for specialty crops. This soil has low potential for building site development and sanitary facilities. It has medium or low potential for most recreation uses.

This soil is suited to crops and to use as pasture. The hazard of erosion is the main concern of management. Wetness also is a limitation if this soil is used for crops. A subsurface drainage system can be used to lower the water table. Conservation tillage, winter cover crops, crop residue, and grassed waterways help to prevent excessive soil loss due to erosion. The surface layer tends to crust after a heavy rain, and this can hinder seedling emergence. The use of crop residue and cover crops helps to improve tilth and increase water infiltration. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. The shrinking and swelling in the subsoil is a limitation to houses that have a basement. Local roads and streets are subject to damage resulting from the low soil strength and the shrinking and swelling of the soil. If this soil is used for local roads and streets, drainage should be improved and a suitable base material used. Wetness is a limitation to many recreation uses.

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

FwA—Fulton-Urban land complex, 0 to 3 percent slopes. This map unit consists of a nearly level, somewhat poorly drained Fulton soil and areas of Urban land. The areas are broad and flat and range from 15 to 80 acres. This unit is about 50 percent Fulton silty clay loam and 35 percent Urban land. The Fulton soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Fulton soil is dark grayish brown silty clay loam about 9 inches thick. The subsoil extends to a depth of about 39 inches. It is mottled, gray, very firm silty clay in the upper part and mottled, brown, yellowish brown, and gray, very firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, yellowish brown, very firm silty clay. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, houses, and other structures have obscured or altered the soil so that identification is not feasible.

Included in mapping and making up about 15 percent of this unit are small areas of the very poorly drained Toledo and Latty soils in low spots and drainageways. In some small areas, the slope is more than 3 percent.

In most areas, the soils in this map unit have been artificially drained. Where the Fulton soil has not been drained, the water table is at or near the surface during extended wet periods. Water sometimes ponds on the surface during wet periods. Permeability is very slow. The organic matter content is moderately low. The subsoil is strongly acid to mildly alkaline.

The Fulton soil is used for parks, open spaces, lawns, and gardens. It has medium potential for lawns, vegetables, flower gardens, trees, and shrubs. It has medium to low potential for recreation uses.

If the Fulton soil is drained, it is moderately suited to grasses, flowers, vegetables, trees, and shrubs. Onsite investigation is necessary to determine the best method of drainage in individual areas. The very slow permeability in the subsoil and the limited availability of suitable drainage outlets are limitations to the use of a subsurface drainage system. Open-ditch drainage is commonly used in this map unit. Water-tolerant perennial plants should be selected for planting. Erosion generally is not a hazard unless the soil is bare of vegetation.

The Fulton soil is limited for building site development by seasonal wetness. If this soil is used as a building site, drainage needs to be improved. This soil is better suited to buildings that do not have a basement than to those that do. Basement walls can be damaged by the shrinking and swelling of this soil. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse when the soil is saturated. This soil is limited for use as septic tank absorption fields by wetness and very slow permeability.

The Fulton soil is in capability subclass IIIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

Gf—Gilford fine sandy loam. This is a nearly level, deep, very poorly drained soil on outwash plains, terraces, and deltas. It is in irregularly shaped areas on broad flats and in long, narrow concave areas. The areas range from 4 to 60 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is black fine sandy loam about 9 inches thick. The subsurface layer, between depths of 9 and 14 inches, is very dark gray fine sandy loam. The subsoil extends to a depth of about 37 inches. It is mottled, gray, friable fine sandy loam in the upper part and mottled, gray, friable loamy fine sand in the lower part. The substratum, to a depth of about 60 inches, is mottled, gray loamy fine sand.

Included in mapping are Tedrow soils on small oval rises or narrow ridges. Also included are areas of Granby soils, which have more sand than this Gilford soil, and some narrow areas of Colwood soils. These included soils make up about 20 percent of this map unit.

Runoff is slow or ponded. Permeability is moderately rapid. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is high. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland. It has high potential for use as cropland and for the development of habitat for wetland wildlife. This soil has low potential for use as woodland and for building site development and sanitary facilities.

If this soil is used for crops, the drainage needs to be improved. If outlets are available, a subsurface drainage system can be used to lower the water table. The local ponding that frequently occurs after a heavy rain can damage crops. Wind erosion is a hazard if this soil is dry and bare of vegetation. Returning crop residue to the soil helps to maintain the organic matter content.

This soil is suited to a variety of pasture grasses. If this soil is used as pasture, grazing should be restricted when the soil is wet to prevent damage to plants and to reduce surface compaction.

This soil has limited suitability for trees. Trees selected for planting should be tolerant of wetness (fig. 7). The use of harvesting equipment is restricted when the soil is wet. Seedling mortality and plant competition are limitations to woodland productivity.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, subsurface drainage can be used to lower the water table. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation for recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 4w.

Gr—Granby loamy fine sand. This is a nearly level, deep, very poorly drained soil on outwash plains. It is in irregularly shaped areas on broad flats and in long, narrow, concave areas. The areas range from 2 to 200 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is black loamy fine sand about 12 inches thick. The subsoil extends to a depth of about 27 inches. It is mottled, dark gray, very friable fine sand in the upper part and mottled, grayish brown, loose fine sand in the lower part. The substratum, to a depth of about 60 inches, is mottled, light brownish gray fine sand. In some areas, a layer of organic material as much as 6 inches thick is in the surface layer.

Included in mapping and making up about 20 percent of this unit are areas of the somewhat poorly drained Tedrow soils on small oval rises.

Runoff is slow or ponded. Permeability is rapid. Where this soil has been drained, the root zone is deep and the available water capacity is low. The organic matter content is moderate. The subsoil is slightly acid. The water table is at the surface during extended wet periods. Water generally is available for crops during dry periods.

In most areas, this soil is used as cropland and woodland. It has medium potential for these uses. This soil has high potential for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities.

If this soil is used for crops, drainage needs to be improved. If outlets are available, a subsurface drainage system can be used to lower the water table. This soil is subject to frequent ponding, which can adversely affect wheat production. Wind erosion is a hazard when this soil is dry and bare of vegetation. Crop residue should be left on the surface to help control erosion.

This soil is suited to a variety of pasture grasses. For best results, grasses tolerant of a high moisture content should be established. If this soil is used as pasture, grazing should be restricted when the soil is wet to prevent damage to plants.

Figure 7.—Gilford fine sandy loam is suited to trees; however, because of seasonal wetness, water-tolerant trees should be selected for planting.

If this soil is used as woodland, water-tolerant trees should be selected for planting. Seasonal wetness and ponding are limitations to the use of harvesting equipment.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, subsurface drainage generally can be used to lower the water table. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used.

The capability subclass is IIIw; the woodland suitability subclass is 4w.

Gs—Granby-Urban land complex. This map unit consists of a nearly level, very poorly drained Granby soil and areas of Urban land. It is in elongated and broad areas on flats that have been developed for residential and commercial use. The areas range from 5 to 120 acres. This unit is 30 to 70 percent Granby loamy fine sand and 25 to 40 percent Urban land. The Granby soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Granby soil is black loamy fine sand about 12 inches thick. The subsoil extends to a depth of about 27 inches. It is mottled, dark gray, very friable fine sand in the upper part and mottled, grayish brown, loose fine sand in the lower part. The substratum, to a depth of about 60 inches, is mottled, light brownish gray fine sand. In places, the soil has been radically altered; low areas have been filled during construction, and other areas have been truncated.

Urban land consists of areas where streets, parking lots, and other structures have obscured or altered the soil so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of Ottokee and Tedrow soils. The moderately well drained Ottokee soils are on the higher knolls and ridges. The somewhat poorly drained Tedrow soils are on low knolls.

In most areas, the soils in this map unit have been artificially drained. Where the Granby soil has not been drained, the water table is at or above the surface during extended wet periods. Some areas are subject to frequent ponding caused by runoff from adjacent, higher lying soils and from urban structures. Permeability of the Granby soil is rapid. The organic matter content is moderate. The subsoil is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part.

The Granby soil is used for parks, open spaces, lawns, and gardens. It has medium potential for vegetables and flower gardens and low potential for lawns, trees, and shrubs. It has low potential for many recreation uses.

If Granby soil is drained, it is suited to grasses, flowers, and vegetables. Water-tolerant trees, shrubs, and other perennial plants should be selected for planting. If outlets are available, several methods of artificial drainage can be used. Water erosion generally is not a hazard unless the soil is bare of vegetation. Wind erosion is a hazard if this soil is dry and bare of vegetation.

The Granby soil is limited for building site development by the seasonal wetness. If this soil is used as a building site, it needs to be artificially drained. It is better suited to buildings that do not have a basement than to those that do. If this soil is used for local roads and streets or parking lots, drainage should be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet. This soil is limited by wetness for use as septic tank absorption fields.

The Granby soil is in capability subclass IIIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

HnA—Haskins loam, 0 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on outwash plains, terraces, and beach ridges. It is on oval knolls and moderately broad flats and in elongated areas on beach ridges. The areas range from 2 to 15 acres.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of about 28 inches. It is mottled, brown, grayish brown, and dark yellowish brown, firm and friable clay loam, sandy clay loam, and sandy loam in the upper part and mottled, grayish brown, firm clay in the lower part. The substratum, to a depth of about 60 inches, is grayish brown clay.

Included in mapping are narrow areas of Mermill soils in drainageways and depressions. Also included are small areas of Digby, Metamora, and Nappanee soils. These included soils make up about 15 percent of this unit.

Runoff is slow. Permeability is moderate in the upper part of the soil and very slow in the substratum. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderate. The subsoil is slightly acid to mildly alkaline. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland. It has high potential for use as cropland and woodland. This soil has low potential for building site development and sanitary facilities and medium potential for recreation uses.

This soil is well suited to crops and to use as pasture. Wetness is a moderate limitation. If outlets are available, a subsurface drainage system can be used to lower the water table. Water erosion is a hazard in the more sloping areas. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration. If this soil is used as pasture, grazing should be restricted during wet periods to prevent surface compaction and damage to plants.

This soil is well suited to trees. Water-tolerant trees should be selected for planting. The use of harvesting equipment is restricted when the soil is wet.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, a subsurface drainage system can be used to lower the water table. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage caused by frost action and low soil strength. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a moderate limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 2w.

Ho—Hoytville clay loam. This is a nearly level, deep, very poorly drained soil on till plains. It is on broad flats and in long, narrow drainageways. The areas range from 5 to several hundred acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is very dark grayish brown clay loam about 9 inches thick. The subsoil extends to a depth of about 45 inches. It is mottled, dark grayish brown, firm and very firm clay. The substratum, to a depth of about 60 inches, is mottled, yellowish brown, very firm clay.

Included in mapping are Nappanee, Metamora, and Haskins soils on small knolls. Also included are areas where the surface layer is clay. The included soils make up about 10 percent of this map unit.

Runoff is very slow or ponded. Permeability is moderately slow in the subsoil and slow in the substratum.

Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is high. The subsoil is slightly acid to neutral. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland. The main crops are corn, soybeans, and small grains. Truck crops and specialty crops are grown in some drained areas. This soil has high potential for crops and for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities.

Wetness is a moderate limitation to the use of this soil as cropland. If outlets are available, a subsurface drainage system can be used to lower the water table. Artificial drainage improves plant growth and makes fieldwork easier by allowing the soil to dry out earlier in spring. The use of crop residue and cover crops helps to improve tilth and increase water infiltration.

If this soil is used as pasture, grazing should be restricted during wet periods to prevent surface soil compaction and damage to plants.

This soil is suited to trees. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed. The use of harvesting equipment is restricted when the soil is wet. Wetness increases seedling mortality.

This soil is limited for building site development and sanitary facilities by wetness and the hazard of ponding. The swelling and shrinking in the subsoil is a limitation to houses that have a basement. Local roads and streets are subject to damage caused by the high shrink-swell potential and by frost action. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 3w.

La—Lamson fine sandy loam. This is a level and nearly level, very poorly drained soil on outwash plains and deltas. It is on broad flats and in slight depressions. The areas range from 2 to 40 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is very dark brown fine sandy loam about 9 inches thick. The subsoil extends to a depth of about 46 inches. It is mottled, grayish brown, friable very fine sandy loam in the upper part and mottled, yellowish brown and grayish brown, firm loam in the lower part. The substratum, to a depth of about 60 inches, is mottled, grayish brown, loose very fine sand that has thin bands of silt. In some areas, the surface layer is somewhat darker and is more than 10 inches thick.

Included in mapping are small areas of Dixboro and Bixler soils on small knolls. Also included are areas of Colwood soils, which have more clay in the subsoil. These included soils make up about 15 percent of this map unit.

Runoff is slow or ponded. Permeability is moderately rapid. Where this soil has been drained, the root zone is deep and the available water capacity is high. The organic matter content is high. The subsoil is slightly acid to mildly alkaline. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland, for which it has high potential. This soil has low potential for building site development and sanitary facilities, for most recreation uses, and for use as woodland.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. If outlets are available, a subsurface drainage system can be used to lower the water table. This soil is subject to ponding, which can adversely affect wheat production. Wind erosion is a hazard when the soil is dry and bare of vegetation. The use of cover crops and crop residue helps to reduce erosion and to maintain the organic matter content. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet. Wetness increases plant competition and seedling mortality on this soil.

This soil is limited for building site development and sanitary facilities by the seasonal high water table and the hazard of ponding. If outlets are available, artificial drainage can be used to lower the water table. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 4w.

Lc—Latty silty clay. This is a nearly level, deep, very poorly drained soil on lake plains. It is on broad flats and in long, narrow depressions. The areas range from 10 to 300 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is dark grayish brown silty clay about 10 inches thick. The subsoil extends to a depth of about 46 inches. It is mottled, gray, very firm silty clay. The substratum, to a depth of about 65 inches, is mottled, gray silty clay. In some areas, the surface layer is somewhat darker than is typical.

Included in mapping are Fulton soils on small oval rises. Also included are some areas of the somewhat darker Toledo soils in drainageways. These included soils make up about 15 percent of this map unit.

Runoff is slow or ponded. Permeability is very slow. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderate. The subsoil is neutral. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland. The main crops are corn, soybeans, and small grains. Truck crops and specialty crops are grown where drainage has been improved. This soil has high potential for crops and for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities and for some recreation uses.

If this soil is used as cropland, wetness is a severe limitation. If outlets are available, a subsurface drainage system can be used to lower the water table. Surface ditches also are used. Artificial drainage improves plant growth and facilitates fieldwork by allowing the soil to dry out and warm up earlier in spring. If this soil is worked when wet, the surface compacts, thus hindering seedling emergence. If this soil is plowed in fall, wind erosion can occur when the surface dries. The use of cover crops and crop residue helps to improve tilth and increase water infiltration.

If this soil is used as pasture, grazing should be restricted during wet periods to prevent surface compaction and damage to plants.

This soil is suited to trees that are tolerant of wetness. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed. The use of harvesting equipment is restricted when the soil is wet. Soil wetness increases seedling mortality and the hazard of windthrow.

This soil is limited for building site development and sanitary facilities by the seasonal high water table and the hazard of ponding. The shrinking and swelling in the subsoil is a limitation for houses that have a basement. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to most recreation uses.

The capability subclass is IIIw; the woodland suitability subclass is 3w.

Lf—Lenawee silty clay loam. This is a nearly level, deep, very poorly drained soil in broad, level upland areas of outwash plains and deltas. It is on irregularly shaped flats and in long, narrow depressions. The areas range from 10 to 90 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is very dark gray silty clay loam about 9 inches thick. The subsoil extends to a depth of about 45 inches. It is mottled, grayish brown, firm silty clay in the upper part and grayish brown, very firm and firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, olive gray, firm silty clay loam.

Runoff is very slow or ponded. Permeability is moderately slow. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is high. The subsoil is neutral to mildly alkaline. The water table is at the surface during extended wet periods. This soil is subject to frequent ponding.

In most areas, this soil is used as cropland. Tomatoes and other truck crops are occasionally grown in areas where the drainage has been improved. This soil has high potential for crops and for the development of habitat for wetland wildlife. It has medium potential for use as woodland. This soil has low potential for building site development and sanitary facilities and for most recreation uses.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. The surface of the soil tends to crust after a heavy rain, thus hindering seedling emergence. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet. Wetness increases plant competition and seedling mortality on this soil.

This soil is limited for building site development and sanitary facilities by the seasonal high water table and the hazard of ponding. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 2w.

Lg—Lenawee-Urban land complex. This map unit consists of nearly level, very poorly drained Lenawee soils and areas of Urban land. It is in broad, flat areas that range from 10 to 200 acres. This complex is about 30 to 60 percent Lenawee loam and silty clay loam and 25 to 45 percent Urban land. The Lenawee soils and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of Lenawee soils is very dark gray silty clay loam about 9 inches thick. The subsoil extends to a depth of about 47 inches. It is mottled, grayish brown, firm silty clay. The substratum, to a depth of about 60 inches, is mottled, olive gray, firm silty clay loam. In places, the soil has been altered by cutting, filling, and leveling during construction.

Urban land consists of areas where streets, parking lots, houses, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of the somewhat poorly drained Del Rey, Haskins, and Dixboro soils on slight knolls and ridges.

In most areas, the soils in this map unit have been artificially drained. Where the Lenawee soils have not been drained, the water table is at or near the surface during extended wet periods. The soils are subject to frequent ponding. Permeability is moderately slow. The organic matter content is high. The subsoil is medium acid to mildly alkaline.

The Lenawee soils are used for parks, open spaces, lawns, and gardens. They have low potential for lawns, vegetables, flower gardens, trees, and shrubs and for recreation uses.

If the Lenawee soils are drained, they are suited to grasses, flowers, vegetables, trees, and shrubs. If outlets are available, subsurface drainage is the most effective for draining excess water from the soil. Water-tolerant perennial plants should be selected for planting. Erosion generally is not a hazard unless the soils are bare of vegetation.

Lenawee soils are limited for building site development and playgrounds by wetness. If these soils are used as a site for buildings or playgrounds, they should be artificially drained. These soils are better suited to buildings that do not have a basement than to those that do. The shrinking and swelling in the subsoil can damage basement walls. If these soils are used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet. These soils are not well suited to use as septic tank absorption fields.

The Lenawee soils are in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

Mf—Mermill loam. This is a nearly level, very poorly drained soil on outwash plains, terraces, and beach ridges. It is on broad flats and in narrow, elongated drainageways. The areas range from 2 to 20 acres. This soil receives runoff from adjacent, higher lying soils and is subject to ponding.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil extends to a depth of about 31 inches. It is mottled, dark grayish brown, firm loam, sandy clay loam, and clay loam in the upper part and mottled, grayish brown, firm clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, grayish brown clay loam. In some areas, the surface layer is sandy loam.

Included in mapping are Haskins and Metamora soils on small rises. Also included are small areas where the clayey material in this soil is at a depth of more than 40 inches. These included soils make up about 20 percent of this unit.

Runoff is slow or ponded. Permeability is moderate in the upper part of the soil and very slow in the lower part. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is high. The subsoil is slightly acid in the upper part and neutral in the lower part. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland. The main crops are corn, soybeans, and small grains. Truck crops and specialty crops are grown in areas where the drainage has been improved. This soil has high potential for use as cropland and woodland and for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities and for many recreation uses.

This soil is well suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of crop residue and cover crops helps to improve the organic matter content and reduce erosion. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet. Seedling mortality, the windthrow hazard, and plant competition are limitations to woodland productivity on this soil.

This soil is limited for building site development and sanitary facilities by the seasonal high water table and the hazard of ponding. The shrinking and swelling of the clayey material in the lower part of the subsoil is a limitation to houses that have a basement. Local roads and streets are subject to damage caused by wetness, low soil strength, or ponding. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 2w.

Mh—Mermill-Urban land complex. This map unit consists of a nearly level, very poorly drained Mermill soil and areas of Urban land. It is in narrow, elongated areas and broad areas on flats that have been developed for residential and commercial uses. The areas range from 5 to several hundred acres. This complex is 30 to 70 percent Mermill loam and 20 to 40 percent Urban land. The Mermill soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Mermill soil is very dark grayish brown loam about 8 inches thick. The subsoil extends to a depth of about 31 inches. It is mottled, dark grayish brown and gray, firm loam, sandy clay loam, and clay loam in the upper part and mottled, grayish brown, firm clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, grayish brown firm clay loam. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, and other structures have altered or obscured the soils so that identification is not feasible.

Included in mapping and making up 5 to 20 percent of this unit are small areas of Haskins, Metamora, Latty, and Toledo soils. The somewhat poorly drained Haskins and Metamora soils are on low knolls and ridges. The very poorly drained Latty and Toledo soils have more clay in the surface layer and the upper part of the subsoil than the Mermill soil.

In most areas, the soils in this map unit have been artificially drained. Where the Mermill soil has not been drained, the water table is at the surface during extended wet periods. Permeability is moderate in the surface layer and the upper part of the subsoil and slow or very slow in the lower part of the subsoil and in the substratum. The subsoil is slightly acid to moderately alkaline. The organic matter content is high.

The Mermill soil is used for parks, open spaces, lawns, and gardens. It has high potential for lawns, vegetables, flower gardens, trees, and shrubs. It has low potential for most recreation uses.

If the Mermill soil is drained, it is well suited to grasses, flowers, vegetables, trees, and shrubs. Where outlets are available, subsurface drainage is the most effective in draining excess water from the soil. Water-tolerant trees, shrubs, and other perennial plants should be selected for planting. Erosion generally is not a hazard unless the soil is bare of vegetation.

The Mermill soil is limited for building site development by wetness and low soil strength. If this soil is used as a site for buildings, it needs to be artificially drained and protected from ponding. This soil is better suited to buildings that do not have a basement than to those that do. The shrinking and swelling of the clayey material in the subsoil can damage basement walls. Local roads and streets are subject to damage caused by wetness, ponding, or low strength. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet. This soil is poorly suited to use as septic tank absorption fields.

The Mermill soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

MmA—Metamora sandy loam, 0 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on outwash plains and beach ridges. It is on oval knolls and moderately broad flats. The areas on beach ridges generally are narrow and elongated. The areas range from 2 to 40 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil extends to a depth of about 31 inches. It is mottled, brown and dark grayish brown, friable and firm sandy loam and sandy clay loam in the upper part and mottled, dark grayish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is mottled, grayish brown, firm clay loam.

Included in mapping are narrow areas of Mermill soils in drainageways and depressions. Also included are small areas of Digby, Haskins, and Rimer soils. These included soils make up about 15 percent of this unit.

Runoff is slow. Permeability is moderately rapid in the upper part of the soil and moderately slow in the lower part. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderate. The subsoil is slightly acid to neutral. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland. In some areas, it is used for specialty crops. This soil has high potential for use as cropland and woodland. It has low potential for building site development and sanitary facilities and medium potential for most recreation uses.

This soil is well suited to crops and to use as pasture. Wetness is a moderate limitation. If outlets are availabale, a subsurface drainage system can be used to lower the water table. The surface layer is friable and can be tilled within a wide range in moisture content. Water erosion is a hazard in the more sloping areas. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of cover crops and crop residue helps to control erosion.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness.

This soil is limited to building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage caused by frost action and the low soil strength. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a moderate limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 3o.

Mu—Muskego muck. This is a nearly level, very poorly drained soil on outwash plains and deltas. It is on long, broad flats and in narrow concave areas. The areas range from 4 to 80 acres. This soil is subject to frequent flooding.

Typically, the surface layer is black muck (sapric material) about 12 inches thick. The layer between depths of 12 and 36 inches is dark grayish brown and very dark grayish brown, friable muck (sapric material). The underlying material, to a depth of about 60 inches, is very dark gray coprogenous earth.

Included in mapping are small areas of Granby, Lamson, and Toledo soils on narrow ridges. Also included are areas of fill material and areas where the soil has underlying material of marl or clay. The included soils make up about 15 percent of this unit.

Runoff is very slow. Permeability is moderately slow to moderately rapid in the upper part of the soil and slow in the underlying material. The available water capacity is very high. The depth of rooting is affected by the water table. The layer between depths of 12 and 36 inches is slightly acid to neutral. During extended wet periods, the water table is at the surface, and the soil is frequently flooded.

In most areas, this soil is idle. In some areas, it is used as cropland. If this soil is drained, it has high potential for crops. It has low potential for use as woodland, for building site development, for sanitary facilities, and for many recreation uses. This soil has high potential for the development of habitat for wetland wildlife.

If this soil is drained, it is suited to crops and to use as pasture. A subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is dry and bare of vegetation. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and damage to plants.

This soil is suited to trees that are tolerant of wetness. The use of harvesting equipment is restricted by wetness and the low soil strength. The windthrow hazard, seedling mortality, and plant competition are other limitations to the use of this soil as woodland.

This soil is limited for building site development and sanitary facilities by the low soil strength, the seasonal high water table, and the hazard of flooding. The underlying coprogenous earth shrinks and forms large cracks when it dries, and it is slow to rewet. Local roads and streets are subject to damage caused by frost action, wetness, and the unstable soil material. Wetness and the organic surface layer are limitations to recreation uses.

The capability subclass is IVw; the woodland suitability subclass is 3w.

NnA—Nappanee loam, 0 to 3 percent slopes. This is a nearly level, deep, somewhat poorly drained soil on broad, level till plains. It is in irregularly shaped areas on knolls and in long, narrow areas. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil extends to a depth of about 33 inches. It is mottled, dark brown, very firm clay in the upper part and mottled, dark grayish brown, very firm clay in the lower part. The substratum, to a depth of about 60 inches, is mottled, dark grayish brown, extremely firm clay.

Included in mapping are small areas of the somewhat darker Hoytville soils in drainageways and low spots. Also included are small areas of Haskins and Metamora soils, which have more sand in the surface layer and the upper part of the subsoil than this Nappanee soil. Areas of soils that have a surface layer of heavy clay loam to silty clay are also included. These included soils make up about 20 percent of this unit.

Runoff is slow. Permeability is very slow. The root zone is deep, and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is slightly acid to mildly alkaline. The water table is between depths of 1 and 2 feet during extended wet periods.

In most areas, this soil is used as cropland, for which it has medium potential. Tomatoes, sugar beets, and other specialty crops are occasionally grown in areas where drainage has been improved. This soil has medium potential for use as woodland and for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities and medium or low potential for many recreation uses.

This soil is suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. This soil warms early in spring and has a friable seedbed. The use of cover crops and crop residue can improve tilth and increase water infiltration. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. Excluding livestock from the woodlots improves timber production. Plant competition can be reduced by spraying, mowing, and disking.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. The high shrink-swell potential and seasonal wetness are limitations to buildings that have a basement. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage should be improved and a suitable base material used. Wetness is a limitation to most recreation uses.

The capability subclass is IIIw; the woodland suitability subclass is 3c.

OaB—Oakville fine sand, 2 to 6 percent slopes. This is a gently sloping, deep, well drained soil on long, narrow beach ridges and oval sand dunes. The areas range from 2 to 20 acres.

Typically, the surface layer is black fine sand about 2 inches thick. The subsurface layer is dark grayish brown fine sand about 4 inches thick. The subsoil extends to a depth of about 24 inches. It is dark brown, yellowish brown, and brown, very friable and loose fine sand. The substratum, to a depth of about 80 inches, is pale brown fine sand. In places, the surface layer has been lost through wind erosion.

Included in mapping are small areas of Ottokee and Tedrow soils in low positions on the landscape. Also included are areas of Granby soils in drainageways and low, wet spots. In some areas on the side slopes of ridges, the slope is more than 6 percent. These included areas make up about 15 percent of this unit.

Runoff is slow. Permeability is very rapid, and the available water capacity is low. The root zone is deep. The organic matter content is low. The subsoil is slightly acid.

In most areas, this soil is used as cropland and woodland. It has low potential for crops and medium potential for use as woodland. This soil has high potential for building site development and sanitary facilities. It has low potential for recreation uses.

Droughtiness is the main limitation to the use of this soil as cropland or pasture. If this soil is cultivated, wind erosion is a hazard during the period before crops are large enough or dense enough to protect the soil. Conservation tillage and winter cover crops help to prevent excessive soil loss. Returning crop residue or adding other organic material to the soil helps to reduce wind erosion and delay surface drying.

This soil is well suited to trees. Trees selected for planting should be tolerant of droughtiness. If this soil is used as woodland, the undesirable species and poorly formed trees should be removed and livestock excluded.

This soil can be used for building site development and sanitary facilities. The walls of shallow excavations tend to collapse, especially when the soil is wet. Establishing and maintaining grass for lawns is difficult because of the droughtiness of this soil. If this soil is dry and bare of vegetation, it is subject to wind erosion. If this soil is used as septic tank absorption fields, groundwater pollution is a hazard. The sandy texture of the surface layer is a limitation to some recreation uses.

The capability subclass is IVs; the woodland suitability subclass is 3s.

OaC—Oakville fine sand, 6 to 18 percent slopes. This is a moderately sloping to moderately steep, deep, well drained soil on the side slopes of long, narrow beach ridges and sand dunes. Most areas range from 2 to 15 acres.

Typically, the surface layer is very dark grayish brown fine sand about 3 inches thick. The subsurface layer is dark grayish brown fine sand about 4 inches thick. The subsoil extends to a depth of about 23 inches. It is brown and yellowish brown, loose fine sand. The substratum, to a depth of about 80 inches, is brown fine sand.

Included in mapping are small areas of Ottokee and Tedrow soils in low positions on the landscape. Also included are areas of Granby soils in drainageways and at the base of slopes. In some areas, the slope is more than 18 percent. The included soils make up about 15 percent of this unit.

Runoff is moderate. Permeability is very rapid. The root zone is deep, and the available water capacity is low. The organic matter content is low. The subsoil is slightly acid.

In most areas, this soil is used as woodland. In some areas it is used as cropland. This soil has low potential for crops and medium potential for use as woodland. It has medium potential for building site development and sanitary facilities and low potential for recreation uses.

Droughtiness is the main limitation to the use of this soil for crops. The steepness of slopes and the hazard of wind erosion also are limitations. This soil is most susceptible to wind erosion when it does not have an adequate vegetative cover. Conservation tillage and winter cover crops help to prevent excessive soil loss.

If this soil is used as pasture, droughtiness and the loose surface soil are limitations. Overgrazing pasture reduces the plant population.

This soil is well suited to trees. Trees selected for planting should be tolerant of droughtiness. If this soil is used as woodland, the undesirable species and poorly formed trees should be removed and livestock excluded.

This soil is limited for building site development and sanitary facilities by the steepness of slopes. The walls of excavations can collapse, especially when the soil is wet. Droughtiness generally makes lawn management difficult. Wind erosion is a hazard if this soil is dry and bare of vegetation. If this soil is used as septic tank absorption fields, ground-water pollution is a hazard. The sandy texture of the surface layer is a limitation to some recreation uses.

The capability subclass is VIs; the woodland suitability subclass is 3s.

OcB—Oakville-Urban land complex, 2 to 12 percent slopes. This map unit consists of a gently sloping to moderately sloping, well drained Oakville soil and areas of Urban land. This unit is on narrow ridges and on knolls. The areas range from 3 to 40 acres. This complex is 40 to 65 percent Oakville fine sand and 25 to 40 percent Urban land. The Oakville soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Oakville soil is dark brown fine sand about 6 inches thick. The subsoil extends to a depth of about 24 inches. It is yellowish brown and brown, very friable and loose fine sand. The substratum, to a depth of about 80 inches, is pale brown fine sand. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of Tedrow and Ottokee soils. The Tedrow soils are on the lower part of slopes and in wet pockets. The Ottokee soils are on the lower ridges and in broad, flat areas.

In most areas, the soils in this map unit have been artificially drained. Permeability is very rapid. The organic matter content is low. The subsoil is medium acid to neutral.

The Oakville soil is used for parks, open spaces, lawns, and gardens. It has low potential for lawns, vegetables, and flower gardens. It has medium potential for trees and shrubs and for recreation uses.

The Oakville soil is poorly suited to grasses, flowers, and vegetables because of droughtiness and the sandy surface texture. This soil dries out early in spring and generally is droughty during dry periods. Lawns are easily damaged by heavy foot traffic when the surface sand is dry and loose. Drought-tolerant perennial plants should be selected for planting. The hazard of water erosion is greatest in the more sloping areas.

The Oakville soil generally is suitable for building site development; however, the walls of excavations tend to collapse. If this soil is used as septic tank absorption fields, the pollution of ground water is a hazard. Droughtiness and the sandy texture of the surface layer are limitations to recreation uses.

The Oakville soil is in capability subclass IVs, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

OtB—Ottokee fine sand, 0 to 6 percent slopes. This is a nearly level to gently sloping, deep, moderately well drained soil on long, broad beach ridges and oval sand dunes. The areas range from 2 to 50 acres.

Typically, the surface layer is dark brown fine sand about 9 inches thick. The subsoil extends to a depth of about 51 inches. It is yellowish brown, loose fine sand in the upper part; in the lower part, it is mottled, light brownish gray and pale brown, very friable fine sand that has thin bands of strong brown, very friable loamy sand. The substratum, to a depth of about 74 inches, is mottled, light brownish gray, loose fine sand. In places, the surface layer is somewhat darker than is typical.

Included in mapping are small areas of Tedrow soils in low positions on the landscape. Also included are areas of Granby soils in drainageways and low, wet areas and areas of Oakville and Spinks soils on the steeper slopes. These included soils make up about 20 percent of this unit.

Runoff is slow. Permeability is rapid, and the available water capacity is low. The root zone is deep. The organic matter content is low. The subsoil is slightly acid to neutral. The water table is at a depth of about 2 feet during extended wet periods.

In most areas, this soil is used as cropland and woodland, for which it has medium potential. It has medium potential for building site development and sanitary facilities and for recreation uses.

This soil is suited to crops and to use as pasture. The main limitation to these uses is droughtiness. The hazard of wind erosion and the seasonal high water table also are limitations. Conservation tillage, winter cover crops, and returning crop residue or adding other organic material to the soil help to reduce wind erosion.

This soil is suited to trees. Trees selected for planting should be tolerant of droughtiness. If this soil is used as woodland, the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. The walls of shallow excavations tend to collapse, especially when the soil is wet. The sandy texture of the surface layer is a limitation to many recreation uses.

The capability subclass is IIIs; the woodland suitability subclass is 3s.

OuB—Ottokee-Urban land complex, 0 to 6 percent slopes. This map unit consists of a nearly level to gently sloping, moderately well drained Ottokee soil and areas of Urban land. It is on broad ridges and in narrow areas on knolls. The areas range from 2 to 100 acres. This unit is about 30 to 60 percent Ottokee fine sand and 25 to 45 percent Urban land. The Ottokee soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Ottokee soil is dark brown fine sand about 9 inches thick. The subsoil extends to a depth of about 51 inches. It is yellowish brown, loose fine sand in the upper part; in the lower part, it is mottled, light brownish gray and pale brown, very friable fine sand that has bands of strong brown, very friable loamy sand. The substratum, to a depth of about 74 inches, is mottled, light brownish gray, loose fine sand. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of Granby, Tedrow, and Oakville soils. Granby soils are darker than the Ottokee soil and are in low, wet areas or drainageways. Tedrow soils are on the lower part of slopes and in pockets. Oakville soils are on the higher ridges and on side slopes along wide ridges.

In most areas, the soils in this map unit have been artificially drained. Where the Ottokee soil has not been drained, the water table is near the surface during wet periods. Permeability is rapid. The organic matter content is low. The subsoil is medium acid to neutral.

The Ottokee soil is used for parks, open spaces, lawns, and gardens. It has low potential for lawns, vegetables, and flower gardens. It has medium potential for trees and shrubs and for recreation uses.

The Ottokee soil is poorly suited to grasses, flowers, and vegetables because of the sandy texture of the surface layer and droughtiness. Lawns can easily be damaged by heavy foot traffic. This soil dries out early in spring and can become droughty in dry periods. Drought-tolerant perennial plants should be selected for planting. Water erosion generally is not a hazard unless the soil is bare of vegetation. Wind erosion is a hazard if the soil is dry and bare of vegetation.

The Ottokee soil is limited for building site development and sanitary facilities by seasonal wetness. If this soil is used as a building site, it should be artificially drained. This soil is better suited to buildings that do not have a basement than to those that do. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet.

The Ottokee soil is in capability subclass IIIs, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

Pq—Pits, quarry. This map unit consists of limestone and sandstone quarries and areas of disturbed land around the quarries. In these areas, the material overlying the limestone or sandstone has been removed and piled. The piled material generally has strongly sloping side slopes and is sparsely vegetated. The quarries generally are deep and have vertical side slopes. Some quarries are filled with water and are used for recreation. The areas of this unit range from about 2 to 480 acres.

This unit is not assigned to a capability subclass or woodland suitability subclass.

Ps—Pits, sand. This map unit consists of sand pits and the areas of disturbed land around the pits. The pits were excavated to a depth of 10 to 15 feet. They have vertical side slopes. Some pits have been partly filled with water. In most areas, there is no vegetation, and water and wind erosion are hazards. The steep sides of the pits tend to collapse. The areas of this unit range from about 2 to 50 acres.

This unit is not assigned to a capability subclass or woodland suitability subclass.

RnA—Rimer loamy fine sand, 0 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil on outwash plains, beach ridges, and deltas. It is on low ridges and knolls. The areas range from 2 to 20 acres.

Typically, the surface layer is dark grayish brown loamy fine sand about 10 inches thick. The subsurface layer, between depths of 10 and 24 inches, is mottled, brown and grayish brown loamy fine sand. The subsoil extends to a depth of about 38 inches. It is mottled, dark brown, firm fine sandy loam in the upper part and mottled, dark grayish brown, very firm silty clay in the lower part. The substratum, to a depth of about 64 inches, is mottled, dark grayish brown, very firm silty clay.

Included in mapping are small areas of Haskins and Metamora soils, which have more clay in the upper part of the soil than this Rimer soil. Also included are areas of Seward soils on the slightly higher rises and Wauseon soils in low spots. These included soils make up about 15 percent of this unit.

Runoff is slow. Permeability is rapid in the upper part of the soil and very slow in the lower part. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is moderately low. The subsoil is medium acid in the upper part and slightly acid to neutral in the lower part. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland, for which it has medium potential. Specialty crops are occasionally grown in areas where drainage has been improved. This soil has medium potential for use as woodland. It has low potential for building site development and sanitary facilities and medium potential for recreation uses.

This soil is suited to crops and to use as pasture. If this soil is used as cropland or pasture, drainage needs to be improved. A subsurface drainage system can be used to lower the water table. Water erosion is a hazard in the steeper areas. Wind erosion is a hazard if the soil is bare of vegetation. The use of cover crops and crop residue helps to control erosion and to improve and maintain the organic matter content.

This soil is well suited to trees. Trees selected for planting should be tolerant of droughtiness.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. The shrinking and swelling of the clayey material in the substratum is a limitation for houses that have a basement. Local roads and streets are subject to damage by frost action. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a moderate limitation to many recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 2s.

Rs—Ross loam, occasionally flooded. This is a nearly level, well drained soil on flood plains. It is in long, narrow areas and on broad flats. The areas range from 5 to 30 acres.

Typically, the surface layer is very dark gray loam about 8 inches thick. The subsurface layer, between depths of 8 and 25 inches, is very dark gray, friable fine sandy loam. The subsoil extends to a depth of about 40 inches. It is dark brown, friable loam. The substratum, to a depth of about 60 inches, is dark brown, friable sandy loam.

Included in mapping are areas of Shoals and Sloan soils in old channels and other places where water accumulates. Also included are small areas where this soil has gray mottles in the subsoil. These included soils make up about 15 percent of this unit.

Runoff is slow. Permeability is moderate, and the available water capacity is high. The root zone is deep. The organic matter content is high. The subsoil is mildly alkaline to moderately alkaline. The seasonal water table is below a depth of 4 feet.

In most areas, this soil is used as cropland and for recreation uses. The main crops are corn and soybeans. This soil has high potential for use as cropland and woodland. It has low potential for building site development and sanitary facilities and medium potential for recreation uses.

This soil is well suited to crops and to use as pasture. The hazard of occasional flooding is the main limitation to these uses. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is well suited to trees. Trees selected for planting should be tolerant of the wetness caused by flooding.

This soil is limited for building site development and sanitary facilities by the hazard of flooding. Local roads and streets can be damaged by flooding. The flooding is a limitation to some recreation uses. Some areas have been protected from flooding and are used as parks.

The capability subclass is IIw; the woodland suitability subclass is 1o.

SdB—Seward loamy fine sand, 2 to 6 percent slopes. This is a nearly level to gently sloping, moderately well drained soil on ridges and knolls of outwash plains, on beach ridges, and on deltas. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown and brown loamy fine sand about 15 inches thick. The subsurface layer, between depths of 15 and 32 inches, is mottled, yellowish brown fine sand. The subsoil extends to a depth of about 38 inches. It is mottled, dark yellowish brown, friable fine sandy loam in the upper part and mottled, brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is mottled, dark yellowish brown, very firm clay loam.

Included in mapping are small areas where the slope is more than 6 percent. Also included are areas of Rimer soils in small depressions or at the base of slopes and small areas of Ottokee soils, which are sandy to a greater depth than this Seward soil. These included soils make up about 20 percent of this unit.

Runoff is slow. Permeability is rapid in the upper part of the soil and slow or very slow in the lower part. The available water capacity is moderate, and the root zone is deep. The organic matter content is moderately low. The subsoil is slightly acid to mildly alkaline. Where this soil has not been drained, the water table is near the surface during wet periods.

In most areas, this soil is used as cropland, for which it has medium potential. Specialty crops are grown in some areas. This soil has high potential for use as woodland. It has low potential for building site development and sanitary facilities and medium potential for recreation uses.

This soil is suited to crops and to use as pasture. The hazard of erosion and droughtiness are the main limitations to these uses. In some areas, drainage needs to be improved to reduce wetness. If necessary, a subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if the soil is dry and bare of vegetation. Water erosion is a hazard in the more sloping areas. Cover crops, crop residue, and minimum tillage help to control erosion.

This soil is well suited to trees. Plant competition is a limitation to use as woodland. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through subsurface drainage. Building sites should be graded so that surface water is drained away from the building foundation. The shrinking and swelling of the clayey substratum material is a limitation to houses that have a basement. Local roads and streets are subject to damage by frost action. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. The slope and the sandy texture of the surface layer are limitations to some recreation uses.

The capability subclass is IIe; the woodland suitability subclass is 2s.

Sh—Shoals loam, occasionally flooded. This is a nearly level, somewhat poorly drained soil on flood plains. It is on broad flats and small knolls. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of about 34 inches. It is mottled, dark brown and grayish brown, firm and friable loam and silty clay loam. The substratum, to a depth of about 60 inches, is mottled, dark brown, stratified loam, silt loam, and clay loam.

Included in mapping are Ceresco soils, which have more sand than this Shoals soil. Also included are areas of Sloan soils in drainageways and low, wet spots and small areas of Eel soils in the higher areas. These included soils make up about 15 percent of this unit.

Runoff is slow. Permeability is moderate. Where this soil has been drained, the root zone is deep and the available water capacity is high. The organic matter content is high. The subsoil is neutral to mildly alkaline. The water table is near the surface during extended wet periods. This soil is subject to occasional flooding.

In most areas, this soil is used as cropland and woodland, for which it has high potential. This soil has low potential for building site development and sanitary facilities and for most recreation uses. It has medium potential for the development of habitat for wetland wildlife.

This soil is well suited to crops and to use as pasture. The suitability of this soil for these uses is affected by the amount of flooding and by the extent to which the drainage of this soil has been improved. Outlets for drainage generally are difficult to locate. If outlets are available, a subsurface drainage system can be used to lower the water table. This soil is suited to most crops; however, winter wheat is subject to damage by flooding. Corn and soybeans generally can be grown, but flooding delays planting in spring. If this soil is used as pasture, grazing should be restricted when the soil is wet to prevent surface compaction and damage to plants.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet and during periods of flooding.

This soil is limited for building site development and sanitary facilities by the occasional flooding and the seasonal high water table. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. The hazard of flooding and wetness are limitations to recreation uses.

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

SmB—Sisson loam, 2 to 6 percent slopes. This is a gently sloping, well drained soil. This soil is mainly on deltas; it is on the slope breaks along drainageways. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil extends to a depth of about 41 inches. It is dark yellowish brown, firm light silty clay loam in the upper part and brown, firm silt loam in the lower part. The substratum, to a depth of about 60 inches, is dark yellowish brown silt loam and silty clay loam.

Included in mapping are Dixboro and Del Rey soils in the less sloping areas. Also included are Colwood and Lenawee soils in drainageways and low, wet spots. These included soils make up about 20 percent of this unit.

Runoff is medium. Permeability is moderate, and the available water capacity is high. The root zone is deep. The organic matter content is moderate. The subsoil is neutral to mildly alkaline. The water table is at a depth of more than 6 feet during extended wet periods. Tilth is good, and the soil can be tilled within a wide range in moisture content.

In most areas, this soil is used as cropland. This soil has high potential for cultivated crops, for use as woodland, and for recreation uses. It has medium potential for building site development and high potential for sanitary facilities.

This soil is well suited to crops and to use as pasture. Water erosion is the main limitation to these uses. Conservation tillage, cover crops, crop residue, and grassed waterways help to reduce erosion. The natural drainage generally is adequate for crops; however, random lines of tile drains are beneficial to crops in local wet spots.

This soil is well suited to trees. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development because of its low strength. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage resulting from the low strength of this soil. A suitable base material should be used in constructing roads and streets. The walls of shallow excavations tend to collapse, especially when the soil is wet. Limitations to recreation uses are slight. The gentle slopes limit the use of this soil for playgrounds.

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

SmC—Sisson loam, 6 to 12 percent slopes. This is a moderately sloping, well drained soil. This soil is mainly on deltas; it is on the slope breaks along major drainageways. The areas range from 2 to 20 acres.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil extends to a depth of about 41 inches. It is yellowish brown, firm light silty clay loam in the upper part and brown, firm silt loam in the lower part. The substratum, to a depth of about 60 inches, is dark yellowish brown silt loam and silty clay loam.

Included in mapping are areas of less sloping Dixboro and Del Rey soils in low spots. Also included are areas of the darker Colwood soils in drainageways and low, wet places. These included soils make up about 15 percent of this unit.

Runoff is rapid. Permeability is moderate, and the available water capacity is high. The root zone is deep. The organic matter content is moderate. The subsoil is neutral to mildly alkaline. The seasonal water table is at a depth of more than 6 feet; however, seep spots form in some areas.

In most areas, this soil is used as woodland or cropland. This soil has high potential for use as woodland and medium potential for use as cropland. It has medium potential for building site development, sanitary facilities, and recreation uses.

This soil is suited to crops and to use as pasture. The hazard of water erosion is the main limitation to these uses. Conservation tillage, cover crops, crop residue, and grassed waterways help to reduce erosion. The natural drainage generally is adequate; however, random lines of tile drains are beneficial to crops in wet spots and seep areas. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and damage to plants.

This soil is well suited to trees. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities because of its low strength and the steepness of slopes. Building sites should be graded so that surface water is drained away from the building foundation. Local roads and streets are subject to damage resulting from the low strength of this soil. Suitable base material should be used in constructing roads and streets. The walls of shallow excavations tend to collapse, especially when the soil is wet. The slope is a limitation to some recreation uses.

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

SmD—Sisson loam, 12 to 18 percent slopes. This is a moderately steep, well drained soil. This soil is mainly on deltas; it is on the slope breaks along major drainageways. The areas range from 2 to 25 acres.

Typically, the surface layer is very dark grayish brown loam about 3 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil extends to a depth of 40 inches. It is yellowish brown, friable silt loam in the upper part and dark yellowish brown and brown, friable silty clay loam and silt loam in the lower part. The substratum, to a depth of about 60 inches, is dark yellowish brown and brown, stratified silt loam, silty clay loam, and very fine sand.

Included in mapping are areas of less sloping Dixboro and Del Rey soils and areas of Colwood soils in drainageways. Also included are some areas where the slopes are more than 18 percent. The included soils make up about 20 percent of this map unit.

Runoff is rapid. Permeability is moderate, and the available water capacity is high. The root zone is deep. The organic matter content is moderate. The subsoil is neutral to mildly alkaline. The water table is at a depth of more than 6 feet during extended wet periods.

In most areas, this soil is used as woodland. In some areas, it is used as pasture. This soil has high potential for use as pasture and woodland. It has low potential for use as cropland and for building site development and sanitary facilities.

This soil is limited for use as cropland because erosion is a severe hazard. Minimum tillage, cover crops, crop residue, and grassed waterways are needed to reduce erosion.

This soil is suited to use as pasture. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and to prevent damage to plants.

This soil is well suited to trees. It this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed. The slope restricts the use of some equipment.

This soil is limited for building site development and sanitary facilities by its low strength and by the steepness of slopes. Seep spots on hillsides are a limitation to buildings, local roads and streets, and other structures. The soil tends to slip if slopes are cut or loaded. A suitable base material is needed if this soil is used for local roads and streets. The slope is a limitation to many recreation uses.

The capability subclass is IVe; the woodland suitability subclass is 1o.

SnB—Sisson-Urban land complex, 2 to 12 percent slopes. This map unit consists of a gently sloping and moderately sloping, well drained Sisson soil and areas of Urban land. It is in broad areas on ridges and in narrow, elongated areas on slope breaks along major drainageways. The areas range from 10 to 40 acres. This map unit is about 35 to 60 percent Sisson loam and 25 to 40 percent Urban land. The Sisson soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Sisson soil is very dark grayish brown and brown loam about 9 inches thick. The subsoil extends to a depth of about 40 inches. It is yellowish brown, friable silt loam in the upper part and dark yellowish brown and brown, friable silty clay loam and silt loam in the lower part. The substratum, to a depth of about 60 inches, is dark yellowish brown and brown, stratified silt loam, silty clay loam, and very fine sand. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 25 percent of this unit are small areas of Colwood, Dixboro, and Bixler soils. The very poorly drained Colwood soils and the somewhat poorly drained Dixboro soils are in drainageways and low spots. The Bixler soils, which have more sand in the surface layer and the upper part of the subsoil than Sisson soils, are on slight ridges and knolls.

In most areas, the soils in this map unit have been artificially drained. Where the Sisson soil has not been drained, the water table is at a depth of about 6 feet during extended wet periods. There are seep spots on the side slopes. Permeability is moderate, and the available water capacity is high. The organic matter content is moderate. The subsoil is slightly acid to moderately alkaline.

The Sisson soil is used for parks, open spaces, lawns, and gardens. It has high potential for lawns, vegetables, flower gardens, trees, and shrubs and for most recreation uses.

The Sisson soil is well suited to grasses, flowers, vegetables, trees, and shrubs. Water erosion is a hazard if the soil is bare of vegetation. The substratum material is highly erodible; if it is exposed, rivulets will quickly form during a rain. Wind erosion is a hazard if this soil is dry and bare of vegetation.

The Sisson soil is limited for building site development by its low strength. The walls of excavations tend to collapse, especially when the soil is wet. There are areas of seepage and slippage on the steeper slopes. A suitable base material should be used in constructing local streets and roads or parking lots because of the low strength of the soil.

The Sisson soil is in capability subclass IIIe, woodland suitability subclass 1o; Urban land is not assigned to a capability subclass or woodland suitability subclass.

So—Sloan loam, occasionally flooded. This is a nearly level, very poorly drained soil on flood plains. It is on broad flats on the smaller flood plains. On the larger flood plains, it is in narrow, elongated areas at the base of slopes and in drainageways. The areas range from 3 to 35 acres.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsurface layer is very dark grayish brown loam about 3 inches thick. The subsoil extends to a depth of about 36 inches. It is mottled, dark grayish brown and grayish brown, friable and firm loam and clay loam. The substratum, to a depth of about 67 inches, is mottled, dark grayish brown, firm loam and clay loam.

Included in mapping are areas of a soil that has more clay in the surface layer and subsoil than this Sloan soil. Also included are areas of Shoals soils on slight rises and narrow, elongated areas of Eel soils near stream channels. These included soils make up about 20 percent of this unit.

Runoff is slow. Permeability is moderate or moderately slow, and the available water capacity is high. The root zone is deep. The organic matter content is high. The subsoil is neutral. The water table is at the surface during extended wet periods. This soil is subject to occasional flooding.

In most areas, this soil is used as cropland and woodland, for which it has high potential. This soil has low potential for building site development and sanitary facilities and for many recreation uses. It has high potential for the development of habitat for wetland wildlife.

This soil is limited for use as cropland by flooding and wetness. Drainage commonly is hindered by the difficulty in locating outlets and by the occasional flooding. This soil is suited to most crops; however, winter wheat is subject to damage by flooding and ponding. Corn and soybeans generally can be grown, but flooding delays planting in spring. Logs, branches, and other debris carried by floodwater commonly are a hazard to crops.

This soil is well suited to use as pasture. Grazing should be restricted when the soil is wet to reduce surface compaction.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet and during periods of flooding.

This soil is limited for building site development and sanitary facilities by the hazard of flooding and the seasonal high water table. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness and the hazard of flooding are limitations to many recreation uses.

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

StB—Spinks fine sand, 2 to 6 percent slopes. This is a gently sloping, deep, well drained soil on long, narrow beach ridges and oval dunes. The areas range from 2 to 15 acres.

Typically, the surface layer is very dark brown fine sand about 2 inches thick. The subsurface layer, to a depth of 22 inches, is dark brown and yellowish brown loamy fine sand and fine sand. The layer below that, which extends to a depth of about 84 inches, is multicolored, loose fine sand that has thin horizontal bands of very friable loamy fine sand. In places, a layer of yellowish brown fine sand 3 to 5 inches thick overlies the surface layer.

Included in mapping are small areas of Ottokee and Tedrow soils in low positions on the landscape. Also included are areas of Granby soils in drainageways and low, wet spots. In some areas, the slope is more than 6 percent. The included soils make up about 20 percent of this unit.

Runoff is slow. Permeability is moderately rapid or rapid, and the available water capacity is low. The root zone is deep. The organic matter content is low. The subsoil is medium acid to neutral. The water table is at a depth of more than 6 feet during extended wet periods.

In most areas, this soil is used as cropland and woodland. It has low potential for crops and medium potential for use as woodland. It has high potential for building site development and sanitary facilities and medium potential for many recreation uses.

This soil is suited to crops and to use as pasture. Droughtiness is the main limitation to these uses. If this soil is cultivated, wind erosion is a hazard during the period before crops are large enough or dense enough to protect the soil. Conservation tillage and winter cover crops help to prevent excessive soil loss. Returning crop residue or adding other organic material to the soil helps to reduce wind erosion and delay the drying of the surface soil.

This soil is suited to trees. Trees selected for planting should be tolerant of droughtiness. If this soil is used as woodland, the undesirable species and poorly formed trees should be removed.

This soil can be used for building site development and sanitary facilities. The walls of shallow excavations tend to collapse. The droughtiness of this soil generally reduces the quality of lawns. Wind erosion is a hazard if the soil is dry and bare of vegetation. If this soil is used as septic tank absorption fields, ground-water pollution is a hazard. The sandy texture of the surface layer is a limitation to some recreation uses.

The capability subclass is IIIs; the woodland suitability subclass is 3s.

SuC2—St. Clair silty clay loam, 4 to 12 percent slopes, eroded. This is a moderately sloping, moderately well drained soil on till plains. It is on long, narrow slope breaks along drainageways. The areas range from 2 to 15 acres.

Typically, the surface layer is dark brown silty clay loam about 6 inches thick. The subsoil extends to a depth of about 26 inches. It is dark yellowish brown, very firm clay. The substratum, to a depth of about 60 inches, is mottled, dark yellowish brown, very firm clay.

Included in mapping are small areas of severely eroded soils and areas where the slope is more than 12 percent. Also included are areas of the somewhat poorly drained Nappanee soils in narrow drainageways. The included soils make up about 15 percent of this map unit.

Runoff is rapid. Permeability is very slow, and the available water capacity is moderate. The root zone is deep. The organic matter content is moderately low. The subsoil is slightly acid. The water table is high in spring.

In most areas, this soil is used as cropland. It has medium potential for use as cropland and woodland. This soil has medium potential for building site development and low potential for sanitary facilities. It has medium potential for recreation uses.

This soil is suited to crops and to use as pasture. The hazard of erosion is the main limitation to these uses. Conservation tillage, cover crops, crop residue, and grassed waterways help to reduce erosion. The surface tends to crust after a heavy rain, thus hindering seedling emergence. Returning crop residue or adding other organic material to the soil helps to reduce surface crusting. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and damage to plants.

This soil is suited to trees. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development and sanitary facilities by its high shrink-swell potential. The very slow permeability also is a limitation to these uses. Local roads and streets are subject to damage caused by the shrinking and swelling of the soil. The very slow permeability and the slope are limitations to some recreation uses.

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

SuE3—St. Clair silty clay loam, 12 to 25 percent slopes, severely eroded. This is a strongly sloping, moderately well drained soil on till plains. It is on long, narrow slope breaks along drainageways. The areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown silty clay loam about 2 inches thick. The subsoil extends to a depth of about 21 inches. It is dark yellowish brown, very firm clay. The substratum, to a depth of about 60 inches, is mottled, dark yellowish brown, very firm clay.

Included in mapping are small areas of moderately eroded soils and areas where the slope is less than 12 percent or more than 25 percent. Also included are areas of the somewhat poorly drained Nappanee soils in narrow drainageways. The included soils make up about 15 percent of this map unit.

Runoff is very rapid. Permeability is very slow, and the available water capacity is moderate. The root zone is deep. The organic matter content is low. The subsoil is slightly acid. The water table is high in spring.

In most areas, this soil is used as pasture and woodland. It has low potential for crops and medium potential for use as pasture and woodland. It has low potential for building site development, sanitary facilities, and most recreation uses.

This soil is poorly suited to crops. It is suited to use as pasture. The hazard of water erosion is the main limitation. Soil loss is excessive if the surface is bare of vegetation. Using this soil as pasture helps to reduce erosion. If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and damage to plants.

This soil is suited to trees (fig. 8). In some areas, the steepness of slopes restricts the use of harvesting equipment. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is limited for building site development, sanitary facilities, local roads and streets, and most recreation uses by the steepness of slopes and the high shrink-swell potential of the soil.

The capability subclass is VIe; the woodland suitability subclass is 3c.

TdA—Tedrow fine sand, 0 to 3 percent slopes. This is a nearly level, somewhat poorly drained soil in long,

Figure 8.—St. Clair silty clay loam is on the side slopes, and Sloan loam is on the nearly level flood plain adjacent to the stream. The St. Clair soil is suitable for trees.

narrow areas on low beach ridges and in oval areas on dunes. The areas range from 2 to 15 acres.

Typically, the surface layer is very dark grayish brown fine sand about 9 inches thick. The subsoil extends to a depth of about 41 inches. It is mottled, yellowish brown and pale brown, very friable and loose fine sand in the upper part and mottled, pale brown and yellowish brown, loose fine sand in the lower part. The substratum, to a depth of about 64 inches, is mottled, light brownish gray and grayish brown, loose fine sand.

Included in mapping are small areas of Gilford and Granby soils in drainageways or in low, wet spots. Also included are areas of Ottokee soils on the top of knolls or in higher positions. These included soils make up about 20 percent of this map unit.

Runoff is slow. Permeability is rapid, and the available water capacity is low. Where this soil has been drained, the root zone is deep. The organic matter content is low. The subsoil is slightly acid or neutral. The water table is near the surface during extended wet periods.

In most areas, this soil is used as cropland or woodland. It has medium potential for these uses. It has low potential for building site development and sanitary facilities and medium potential for recreation uses.

If this soil is used for crops, drainage needs to be improved. If outlets are available, a subsurface drainage system can be used to lower the water table. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of cover crops and crop residue helps to control erosion and to maintain or improve the organic matter content.

This soil is suited to use as pasture. For best results, water-tolerant species should be grown. Grazing should be restricted when the soil is wet to prevent damage to plants.

If this soil is used as woodland, trees that are tolerant of wetness should be established. The use of harvesting equipment is restricted when the soil is wet.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through artificial drainage. Wetness is a limitation for local roads and streets. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to most recreation uses.

The capability subclass is IIw; the woodland suitability subclass is 3o.

TeA—Tedrow-Urban land complex, 0 to 3 percent slopes. This map unit consists of a nearly level, somewhat poorly drained Tedrow soil and areas of Urban land. It is in broad areas on flats and narrow, elongated areas on low ridges. The areas range from 20 to 60 acres. This unit is about 50 percent Tedrow loamy fine sand and 35 percent Urban land. The Tedrow soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Tedrow soil is very dark grayish brown fine sand about 9 inches thick. The subsoil extends to a depth of about 41 inches. It is mottled, yellowish brown and pale brown, very friable and loose fine sand in the upper part and mottled, pale brown and yellowish brown, loose fine sand in the lower part. The substratum, to a depth of about 64 inches, is light brownish gray and grayish brown, loose fine sand. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of Granby and Ottokee soils. The Granby soils are in low, wet areas or drainageways, and the Ottokee soils are on the slightly higher ridges and knolls.

In most areas, the soils in this map unit have been artificially drained. Where the Tedrow soil has not been drained, the water table is near the surface during extended wet periods. Permeability is rapid. The organic matter content is moderately low. The subsoil is slightly acid to neutral.

The Tedrow soil is used for parks, open spaces, lawns, and gardens. It has medium potential for lawns, vegetables, flower gardens, trees, and shrubs. It has low to medium potential for recreation uses.

If the Tedrow soil is drained, it is suited to grasses, flowers, and vegetables. It is well suited to trees and shrubs. If outlets are available, a subsurface drainage system is the most effective in draining excess water from the soil. Water-tolerant perennial plants should be selected for planting. Water erosion generally is not a hazard unless the soil is bare of vegetation or is used as a waterway. Wind erosion is a hazard if the soil is dry and bare of vegetation.

The Tedrow soil is limited for building site development and playgrounds by wetness. Drainage needs to be improved for these uses. This soil is better suited to buildings that do not have a basement than to those that do. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet. This soil is limited by wetness for use as septic tank absorption fields.

The Tedrow soil is in capability subclass IIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

To—Toledo silty clay. This is a nearly level, deep, very poorly drained soil on lake plains and deltas. It is on broad flats and in long, narrow depressions. The areas range from 3 to 100 acres.

Typically, the surface layer is very dark gray silty clay about 9 inches thick. The subsoil extends to a depth of about 47 inches. It is mottled, very firm silty clay that is dark gray in the upper part and gray in the lower part. The substratum, to a depth of about 60 inches, is mottled, gray, very firm silty clay. In some areas, the surface layer is thicker and darker than is typical.

Included in mapping are areas of the somewhat poorly drained Fulton soils on small oval knolls and narrow ridges. Also included are small areas of Mermill soils, which have more sand in the surface layer and in the upper part of the subsoil than this Toledo soil. These included soils make up about 20 percent of this map unit.

Runoff is slow or ponded. Permeability is slow, and the available water capacity is moderate. Where this soil has been drained, the root zone is deep. The organic matter content is high. The subsoil is neutral. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland. The main crops are corn, soybeans, and small grains. Specialty crops can be grown if this soil is adequately drained. This soil has high potential for crops and for the development of habitat for wetland wildlife. It has low potential for building site development and sanitary facilities and for many recreation uses.

If this soil is used as cropland, wetness is a moderate limitation. If suitable outlets are available, a subsurface drainage system can be used to lower the water table. Artificial drainage improves plant growth by allowing the soil to dry out and warm up earlier in spring. In managing cropland, the use of cover crops and crop residue helps to improve tilth and increase water infiltration.

If this soil is used as pasture, grazing should be restricted in wet periods to prevent soil compaction and damage to plants.

This soil is suited to use as woodland. If this soil is used for timber production, grazing livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed. The use of harvesting equipment is restricted when the soil is wet. The seasonal wetness increases seedling mortality and the hazard of windthrow.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. The shrinking and swelling in the subsoil is a limitation for houses that have a basement. Local roads and streets are subject to damage caused by frost action and wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to recreation uses.

The capability subclass is IIIw; the woodland suitability subclass is 3w.

Tp—Toledo silty clay, ponded. This is a nearly level to depressional, very poorly drained soil on lake plains and deltas. It is in long, narrow drainageways and in broad areas on flats. The areas range from 5 to 200 acres.

Typically, the surface layer is very dark gray silty clay about 9 inches thick. The subsoil extends to a depth of about 47 inches. It is mottled, dark grayish brown and grayish brown, very firm silty clay. The substratum, to a depth of about 60 inches, is mottled, grayish brown silty clay. In some areas, a layer of organic material as much as 6 inches thick is in the surface layer.

Included in mapping are small areas of Fulton soils on slight rises. Also included are narrow areas of Latty and Lenawee soils. These included soils make up about 15 percent of this unit.

This soil is frequently ponded. Permeability is slow, and the available water capacity is moderate. The depth of rooting is affected by the height of the water table. The organic matter content is high. The subsoil is neutral. The water table is at the surface during extended wet periods.

In most areas, this soil is used for wildlife habitat. In some areas, it is used as cropland. Most areas of cropland are protected from ponding by levees. If this soil is drained, it has high potential for crops. This soil has low potential for building site development, sanitary facilities, and many recreation uses. It has high potential for the development of habitat for wetland wildlife.

This soil is well suited to crops. If this soil is used for crops, drainage needs to be improved. A subsurface or surface drainage system can be used to lower the water table. The use of cover crops and crop residue helps to control erosion, improve tilth, and increase water infiltration.

If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and prevent damage to plants.

This soil is suited to trees that are tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet and ponded.

This soil is limited for building site development and sanitary facilities by the seasonal high water table and the frequent ponding. If outlets are available, the water table can be lowered through subsurface drainage. Local roads and streets are subject to damage resulting from the low strength of this soil and from wetness. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness is a limitation to many recreation uses.

The capability subclass is IVw; the woodland suitability subclass is 4w.

Ts—Toledo-Urban land complex. This map unit consists of a nearly level, very poorly drained Toledo soil and areas of Urban land. The areas are broad and flat and range from 20 to 300 acres. This unit is about 30 to

60 percent Toledo silty clay and 25 to 45 percent Urban land. The Toledo soil and Urban land are so intermingled or the areas of each are so small that it was not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Toledo soil is very dark gray silty clay about 9 inches thick. The subsoil extends to a depth of about 47 inches. It is mottled, dark grayish brown and grayish brown, very firm silty clay. The substratum, to a depth of about 60 inches, is mottled, grayish brown silty clay. In places, the soil has been altered by cutting and filling during construction.

Urban land consists of areas where streets, parking lots, houses, and other structures have obscured or altered the soils so that identification is not feasible.

Included in mapping and making up about 20 percent of this unit are small areas of the somewhat poorly drained Fulton and Haskins soils on slight knolls and ridges.

In most areas, the soils in this map unit have been artificially drained. Where the Toledo soil has not been drained, the water table is at or near the surface during extended wet periods. Permeability is slow. The organic matter content is high. The subsoil is slightly acid or neutral.

The Toledo soil is used for parks, open spaces, lawns, and gardens. It has low potential for lawns, vegetables, flower gardens, trees, and shrubs and for recreation uses.

If the Toledo soil is drained, it is suited to grasses, flowers, vegetables, trees, and shrubs. If outlets are available, a subsurface drainage system is the most effective for draining excess water from the soil. Water-tolerant perennial plants should be selected for planting. Erosion generally is not a hazard unless the soil is bare of vegetation or is used as a waterway.

The Toledo soil is limited for building site development and playgrounds by wetness. Drainage needs to be improved for these uses. This soil is better suited to buildings that do not have a basement than to those that do. The shrinking and swelling in the subsoil can damage basement walls. If this soil is used for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil is wet. This soil is poorly suited to use as septic tank absorption fields.

The Toledo soil is in capability subclass IIIw, not assigned to a woodland suitability subclass; Urban land is not assigned to a capability subclass or woodland suitability subclass.

Un—Udorthents, sandy. This map unit consists of nearly level areas where sandy material has been removed. The soil material that remains is mainly neutral and calcareous sands. Ridges of the sandy Spinks, Oakville, and Ottokee soils have been leveled and the soil removed for use as fill material in urban construction. A few ridges have only been partly leveled. Some depressional areas have been formed. The areas of this map unit range from 5 to 120 acres.

Included in mapping and making up about 15 percent of the unit are small areas of the very poorly drained Granby soils.

In most areas, the soil material is calcareous at or near the surface. Permeability generally is rapid and the organic matter content very low. There is a seasonal high water table, and many areas are ponded during extended wet periods.

The areas of this unit are used for parks, open spaces, and buildings. The soil has low potential for lawns, gardens, trees, and shrubs and for building site development, sanitary facilities, and most recreation uses.

If the soil material in this unit is drained, it is suited to grasses in most areas. If outlets are available, various systems of artificial drainage can be used. Trees, shrubs, and other perennial plants selected for planting should be highly tolerant of wetness and alkalinity. The soil material on ridges is droughty, and wind erosion is a hazard if the soil is dry and bare of vegetation.

The soil material in this unit is limited for building site development by wetness. If the soil is used as a site for buildings, drainage needs to be improved and the areas protected from ponding. The soil is better suited to buildings that do not have a basement than to those that do. If the soil is used as a site for local roads and streets or parking lots, drainage needs to be improved and a suitable base material used. The walls of shallow excavations tend to collapse, especially when the soil material is wet. The areas of this map unit are not suited to use as septic tank absorption fields.

This map unit is not assigned to a capability subclass or woodland suitability subclass.

Uo—Udorthents, loamy. This map unit consists of nearly level to strongly sloping, loamy soil material in cut and fill areas. The soil in this unit generally consists of mixed organic and inorganic material overlain by a layer of loamy soil material about 2 feet thick. There are some pits in this map unit, mainly near the Ohio Turnpike and Interstate Highways. In these areas, the surface layer, subsoil, and part of the substratum have been removed; the remaining soil material is calcareous clay and silty clay loam.

Included in mapping are stretches of the Ohio Turnpike and Interstate Highways and many areas near the Maumee River. Also included are small areas of sandy and clayey soil material, areas of sanitary landfill, and areas filled with bricks, glass, broken concrete, and other building material. The areas of sanitary landfill generally have been covered with soil material and planted to grass.

Most areas of this map unit are used for urban development and as sites for transportation systems. Some areas are used for parks or open spaces. Most areas that are not being used have been seeded to grass.

The soil material in this unit is suited to trees. Plants and trees selected for planting should be tolerant of alkalinity.

This map unit is not assigned to a capability subclass or woodland suitability subclass.

Up—Udorthents, clayey. This map unit consists of soil material that was dredged from the Maumee River and Maumee Bay. This dredged material is in nearly level areas protected by levees and has been drained. It is mainly silty clay and silty clay loam and includes pockets of sand and gravel. This material is calcareous in places and has many shells.

The soil is calcareous at or near the surface. The seasonal water table is at the surface or within a depth of 2 feet. Plants and grasses selected for planting should be tolerant of wetness and alkalinity.

Most areas of this map unit are idle. Some areas are used for parks and open spaces. The soil has high potential for grasses, trees, and shrubs. It has low potential for building site development and sanitary facilities. During extended dry periods, cracks form at the surface and extend to a depth of about 2 feet.

The shrinking and swelling of the clayey soil material is a limitation to building site development and sanitary facilities. The underlying material is unstable and can cause additional settling.

This map unit is not assigned to a capability subclass or woodland suitability subclass.

Ur—Urban land. This map unit consists mainly of areas of buildings, streets, and parking lots. In the few small areas of open space, the soils have been disturbed. In some areas, short slopes have been formed during construction. Very little natural soil remains, and identification of the original soils is not feasible.

Urban land has been artificially drained using storm sewers and surface drainage structures. Where the natural drainage has not been improved, there are wet spots around or under the urban structures. Frost action commonly causes damage to pavements, patios, walkways, and other structures. Vehicles can cause damage to roads and other paved areas that are underlain by wet spots.

This map unit is not assigned to a capability subclass or woodland suitability subclass.

Wt—Wauseon fine sandy loam. This is a nearly level, deep, very poorly drained soil on outwash plains, beach ridges, and deltas. It is on irregularly shaped, broad flats and in long, narrow depressions. The areas range from 6 to 70 acres.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsurface layer is very dark gray fine sandy loam about 4 inches thick. The subsoil extends to a depth of about 30 inches. It is mottled, gray and grayish brown, friable fine sandy loam. The substratum, to a depth of about 60 inches, is mottled, gray, firm silty clay.

Included in mapping are areas of Tedrow soils on small oval rises of narrow ridges. Also included are areas of Gilford soils, which have more sand in the substratum than this Wauseon soil. These included soils make up about 15 percent of this unit.

Runoff is slow. Permeability is rapid in the upper part of the soil and very slow in the lower part. Where this soil has been drained, the root zone is deep and the available water capacity is moderate. The organic matter content is high. The subsoil is mildly alkaline. The water table is at the surface during extended wet periods.

In most areas, this soil is used as cropland, for which it has high potential. This soil has medium potential for use as woodland. It has low potential for building site development and sanitary facilities and for many recreation uses. This soil has high potential for the development of habitat for wetland wildlife.

If this soil is used as cropland, drainage needs to be improved. If outlets are available, a subsurface drainage system can be used to lower the water table. In some areas, ponding occurs after a heavy rain and can damage crops. Wind erosion is a hazard if this soil is dry and bare of vegetation. The use of cover crops and crop residue helps to maintain the organic matter content.

If this soil is used as pasture, grazing should be restricted when the soil is wet to reduce surface compaction and damage to plants.

This soil is suited to trees. Trees selected for planting should be tolerant of wetness. The use of harvesting equipment is restricted when the soil is wet.

This soil is limited for building site development and sanitary facilities by the seasonal high water table. If outlets are available, the water table can be lowered through artificial drainage.

The capability subclass is IIw; the woodland suitability subclass is 3w.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops; as pasture and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock or wetness can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

James R. Rickenberg, soil conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The main field crops in Lucas County are corn, soybeans, winter wheat, and hay. Crops that are grown to a lesser extent include tomatoes, sugar beets, and potatoes. Only about one percent of the acreage of farmland is in pasture.

The soils in Lucas County vary in their suitability for specific crops, and they require widely different management. However, certain basic management practices are needed on most of the soils in the county: maintaining an adequate level of fertility, improving drainage, controlling erosion, and maintaining or improving soil tilth.

Fertility is naturally low in the sandy soils and medium or high in the loamy and clayey soils. The sandy soils, including the Oakville, Ottokee, Rimer, Seward, and Spinks soils, retain only a small amount of plant nutrients; therefore, they require more frequent additions of fertilizer. Fertilizer should be applied on the basis of soil tests, the needs of the crop, and the desired level of yield. The Cooperative Extension Service can help in determining the kinds and amount of fertilizer to apply.

Soil drainage is the major management need on about 75 percent of the cropland in the survey area. Surface ponding and excessive soil wetness impede crop growth on the very poorly drained and somewhat poorly drained soils. Because these soils dry out and warm up slowly in spring, tillage and planting are delayed. Artificial drainage is necessary to improve crop growth on these soils.

The design of surface and subsurface drainage systems varies with the kind of soil. Surface drainage removes excess water from the surface of the soil. It generally is most effective on the clayey soils, which have relatively slow permeability.

Tile, or subsurface, drainage removes excess water from within the soil. Its effectiveness is dependent on the permeability of the soil and on the availability of suitable outlets.

Tile drainage is most effective in the sandy soils, including the Granby, Gilford, Lamson, and Tedrow soils. It can be used but is not so effective in loamy soils such as Colwood, Mermill, Dixboro, and Haskins soils. Tile drainage is least effective in clayey soils such as Fulton, Latty, and Toledo soils. In the sandy soils and in the loamy Colwood and Dixboro soils, tile lines can become blocked by soil material. Because these soils flow when they are saturated, the tile lines must be protected.

Erosion control practices are needed on about 32 percent of the cropland in the survey area. Water erosion is a hazard on soils that have slopes of more than 3 percent. The loss of surface layer material reduces soil productivity and lowers the available water capacity of the soil. As a result of erosion, heavier textured subsoil material commonly is mixed into the surface layer by plowing, and this generally causes tilth to deteriorate. Soils that are subject to damage by water erosion include the Fulton and St. Clair soils. Minimum tillage, cover crops, grassed waterways, diversions, and the use of crop residue can help to reduce erosion.

Wind erosion is a hazard on the sandy soils and on some of the loamy soils. If winds are strong and the soils are dry and bare of vegetation or surface mulch, wind erosion can damage these soils in a few hours. Maintaining a cover of vegetation or surface mulch or keeping the surface rough through proper tillage can help to reduce wind erosion. Windbreaks also reduce wind erosion.

Soil tilth affects the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous.

The surface layer of the soils in Lucas County ranges from fine sand to silty clay. Soils that have a surface layer of sandy loam or a texture coarser than sandy loam include the Digby, Bixler, Dixboro, Dunbridge, Gilford, Granby, Lamson, Metamora, Oakville, Ottokee, Rimer, Seward, Spinks, and Tedrow soils. These soils can safely be tilled within a wide range in moisture content. Some of these soils, including the Gilford, Granby, and Lamson soils, have poor trafficability when they are wet; however, they will not be seriously damaged if they are tilled when wet.

Soils that have a surface layer of loam include the Colwood, Del Rey, Haskins, Mermill, Nappanee, and Sisson soils. The range in optimum moisture content for tillage on these soils is narrower than on the sandy loam or coarser textured soils, and these loam soils tend to dry more slowly.

Soils that have a silty clay loam or finer textured surface layer include the Fulton, Hoytville, Latty, and Toledo soils. These soils have the narrowest range in optimum moisture content for tillage. The clay content in the surface layer of these soils generally is so high that clodding or flowing and sealing can result if these soils are tilled when wet.

Pasture is a minor land use in Lucas County. The pastureland is mainly in areas of soils that have potential for use as cropland. Some of the soils that are used as pasture have steeper slopes and are subject to erosion; these soils commonly are already eroded and have poor tilth. In most areas of pasture, the soils need to be artificially drained for the maximum growth of pasture plants. Erosion control, drainage, additions of lime and fertilizer, and brush control are needed in managing pasture. In addition, surface compaction needs to be reduced, and on the sandy soils, the plant population needs to be maintained or increased.

The *specialty crops* grown commercially in Lucas County include nursery stock, orchards, and vegetables. These crops require a high level of management for optimum yield. Information on management practices, fertilization rates, and seed varieties for specialty crops is available at the local offices of the Cooperative Extension Service and the Soil Conservation Service.

Most of the nursery stock in Lucas County is produced on the coarse textured soils, mainly Ottokee, Spinks, Tedrow, Bixler, and Granby soils. Nursery plants on these soils produce a good root system, and transplanting is easy.

Many of the orchards are on the medium and coarse textured soils in the western part of the county, mainly Ottokee, Spinks, Sisson, and Bixler soils. The number of orchards in Lucas County is decreasing due to the expanding urbanization in this part of the county.

Sugar beets and tomatoes are among the main specialty crops in the county. Where they have been drained, the Hoytville, Latty, Lenawee, and Toledo soils are well suited to these crops. The heavy textured, very poorly drained soils are used for these crops where drainage has been improved. Poor root growth and disease are limitations on many soils in the county; however, new varieties of sugar beets and tomatoes are being developed that are adaptable to many different soils. Soil drainage is the main requirement in managing the soils for these crops. Reducing soil compaction also is important.

Irish potatoes are grown mainly on the coarser textured soils. Bixler, Dixboro, Rimer, and Tedrow soils and, where they have been drained, Colwood, Gilford, and Lamson soils are well suited to Irish potatoes.

The other major specialty crops in the county are sweet corn and cabbage. These crops can be grown on various kinds of soil, but the early maturing varieties are grown mainly on the coarse textured soils, which warm up earlier in spring. Wind erosion and damage to tender plants by wind are hazards on these soils as long as the vegetation is too short to reduce wind velocity.

Irrigation.—Rainfall in Lucas County generally is adequate for most crops but is not always timely or well distributed. Extended dry periods can occur between May and September.

The acreage under irrigation management has been increasing in recent years as irrigation becomes more economical. In the eastern part of the county, water for irrigation is pumped from deep drainage ditches. In the western part of the county, it is drawn from deep wells and from ponds.

Many of the soils in Lucas County are suited to irrigation. If irrigation water is available, these soils can be irrigated profitably. Features that affect the suitability of a soil for irrigation are available water capacity, slope, water intake rate, and drainage. Fine and medium textured soils have a high available water capacity and generally have a slow intake rate. Coarse textured soils have a low available water capacity and a rapid intake rate.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*8*). Only class and subclass are used in this survey. These levels are defined 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. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Woodland management and productivity

At the time of settlement, nearly all of Lucas County was woodland (see the section "Natural vegetation"). Today, the major areas of woodland are in the Oak Openings. They include the Maumee State Forest and the Oak Openings Metropark. There are many woodlots on farmland in the Oak Openings but few in other parts of the county.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; and 4, moderate. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *w*, indicates excessive water in or on the soil; *c*, clay in the upper part of the soil; and *s*, sandy texture. The letter *o* indicates that limitations or restrictions are insignificant.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blow down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water management

Table 11 gives information on the soil properties and site features that affect water management. The kind of soil limitations is given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock, affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

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

Recreation

More than 6,000 acres of private and public land in Lucas County is used for recreation. The Oak Openings Park, more than 3,000 acres in size, is the largest recreation area. Lake Erie and the Maumee and Ottawa Rivers also are major recreation areas. They are used for boating and fishing.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 12, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 12 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife habitat

Many acres of federal land in Lucas County are used for wildlife habitat; 2,078 acres in the Ottawa wildlife refuge, 2,245 acres in the Cedar Point refuge, and 82 acres in the West Sister Island refuge.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 13, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, smartweed, ragweed, and fall panicum.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, wild cherry, grape, apple, hawthorn, dogwood, hickory, black walnut, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are shrub honeysuckle, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, northern white-cedar, and eastern redcedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, willow, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

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

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

Soil properties

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

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

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

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering properties

Table 14 gives estimates of the engineering classification and of the range of properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

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

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

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

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

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

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

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

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

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. Only saturated zones wihtin a depth of about 6 feet are indicated.

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

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

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and chemical analyses of selected soils

Some of the soils in Lucas County were sampled and laboratory data collected by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained for most samples include particle-size distribution (*6*), reaction, organic matter content (*4*), calcium carbonate equivalent, and extractable cations.

These data were used in the classification and correlation of these soils and in evaluating their suitability for various land uses. Six of the profiles sampled were selected as representative for their respective series and are described in the section "Soil series and morphology." These series and their laboratory identification numbers are: Bixler (LS-6), Del Rey (LS-7), Lamson (LS-11), Latty (LS-10), Oakville (LS-9), and Ottokee (LS-8).

In addition to these data, laboratory data for many of the same soils are available from nearby counties. These data, as well as the Lucas County data, are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Division of Lands and Soil, Ohio Department of Natural Resources, Columbus Ohio; and the state office of the Soil Conservation Service, Columbus, Ohio.

Engineering test data

Several of the soils mapped in Lucas County have been analyzed for engineering properties by the Soil Physical Studies Laboratory, Department of Agronomy, Ohio State University. The moisture density determinations were made in part by the Ohio Department of Transportation, Soil Testing Laboratory. Three of the soils tested are considered representative of their series, and their profiles are described in the section "Soil series and morphology." These series and their laboratory identification number are: Bixler (LS-6), Del Rey (LS-7), and Ottokee (LS-8).

In addition to the soils tested in Lucas County, engineering test data for many of the same series are available from nearby counties. These data and the Lucas County data are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Division of Lands and Soil, Ohio Department of Natural Resources, Columbus, Ohio; and the state office of the Soil Conservation Service, Columbus, Ohio.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Inceptisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquept (*Aqu*, meaning water, plus *ept*, from Inceptisol).

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

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine illitic, nonacid, mesic Typic Haplaquepts.

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

Soil series and morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*9*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Bixler series

The Bixler series consists of deep, somewhat poorly drained soils on outwash plains, beach ridges, and deltas. Bixler soils formed in sandy and loamy material 20 to 35 inches thick over stratified lacustrine material. Permeability is rapid in the sandy material and moderate in the lower part of the subsoil and in the substratum. The slope ranges from 0 to 6 percent.

Bixler soils commonly are adjacent to Lamson soils and are similar to Dixboro, Rimer, and Tedrow soils. Lamson soils have a grayer subsoil than Bixler soils. Dixboro soils have more clay than Bixler soils and they have less sand in the surface layer and the upper part of the subsoil. Rimer soils have more clay in the subsoil and substratum. Tedrow soils are more sandy throughout.

Typical pedon of Bixler loamy fine sand, 0 to 2 percent slopes, about 1 1/2 miles west of Maumee in Monclova Township, 1,700 feet west, 400 feet south of the center of sec. 28:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium granular structure; very friable; common fine roots; few medium black (10YR 2/1) concretions; slightly acid; abrupt smooth boundary.

A21—10 to 19 inches; dark yellowish brown (10YR 4/4) fine sand; common medium distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; very weak medium subangular blocky structure; very friable; few fine roots; slightly acid; clear wavy boundary.

A22—19 to 28 inches; brown (10YR 5/3) fine sand; common medium distinct yellowish brown (10YR 5/6) and pale brown (10YR 6/3) mottles; single grained; loose; few fine roots; few medium black (10YR 2/1) concretions of iron and manganese oxides; neutral; abrupt wavy boundary.

B21tg—28 to 32 inches; light brownish gray (10YR 6/2) fine sandy loam; common medium distinct yellowish brown (10YR 5/4) and few fine faint gray (5Y 5/1) mottles; weak medium subangular blocky structure; friable; few thin discontinuous clay films and clay bridgings on sand grains; few fine black (10YR 2/1) concretions of iron and manganese oxides; neutral; abrupt smooth boundary.

IIB22tg—32 to 34 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; firm; few thin lenses of silty clay loam; weak medium subangular blocky structure; friable; few thin patchy clay films; few fine black (10YR 2/1) concretions of iron and manganese oxides; neutral; abrupt smooth boundary.

IIB3t—34 to 45 inches; yellowish brown (10YR 5/4) silt loam; few medium distinct gray (10YR 6/1) mottles; firm; few thin lenses of silty clay loam; weak medium subangular blocky structure; few thin patchy clay films; few fine black (10YR 2/1) concretions of iron and manganese oxides; neutral; abrupt smooth boundary.

IIC2g—45 to 72 inches; gray (N 5/0) stratified silt loam, very fine sand, and fine sand; thin strata of light silty clay loam that has common medium distinct brown (7.5YR 5/4) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is 24 to 45 inches thick. The sandy material extends to a depth of 20 to 35 inches. The A, B, and B2t horizons are medium acid to neutral; the IIBt horizon is slightly acid to mildly alkaline; and the IIC horizon is neutral to moderately alkaline. The sandy material is 0 to 5 percent gravel.

The Ap horizon has hue of 10YR, value of 2 to 4, and chroma of 1 or 2. The A2 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The texture of the A horizon includes loamy fine sand, loamy sand, and fine sand.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. It ranges from fine sandy loam to sandy loam. The IIB2t horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silt loam or loam.

The IIC horizon has hue of 7.5YR to 5Y, value of 3 to 6, and chroma of 0 to 6.

Ceresco series

The Ceresco series consists of deep, somewhat poorly drained soils. Ceresco soils formed in loamy and sandy alluvium on flood plains. Permeability is moderate or moderately rapid. The slope is 0 to 2 percent.

Ceresco soils commonly are adjacent to Sloan soils and are similar to Shoals soils. Sloan soils have dominant gray colors immediately below the mollic epipedon and have a higher clay content than Ceresco soils. Shoals soils have a higher clay content in the control section than Ceresco soils.

Typical pedon of Ceresco sandy loam, occasionally flooded, about 3 miles northeast of Whitehouse in Monclova Township, 1,800 feet north and 2,200 feet east of the southwest corner of sec. 7, T.1.

Ap—0 to 11 inches; very dark gray (10YR 3/1) sandy loam; weak medium subangular blocky structure; friable; common fine roots; mildly alkaline; abrupt smooth boundary.

B1—11 to 23 inches; dark brown (10YR 4/3) sandy loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few fine roots; common medium distinct black (10YR 2/1) concretions of iron and manganese oxides; few medium distinct very dark grayish brown (10YR 3/2) organic stains; neutral; abrupt wavy boundary.

B2g—23 to 36 inches; grayish brown (10YR 5/2) sandy loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; common medium distinct dark brown (7.5YR 3/2) organic stains; slight effervescence; mildly alkaline; abrupt wavy boundary.

Cg—36 to 60 inches; grayish brown (10YR 5/2) sandy loam that has strata of sand and loamy sand; many medium distinct yellowish brown (10YR 5/4) and common medium faint dark grayish brown (10YR 4/2) mottles; massive; loose; slight effervescence; moderately alkaline.

The depth to free carbonates is more than 28 inches. Coarse fragments make up 0 to 5 percent of the soil material in the upper 20 inches and 0 to 20 percent of the soil material below that.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B2g horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It has few to many mottles that have chroma of 3 or more. The B horizon is sandy loam or fine sandy loam; it has subhorizons of loamy sand in some pedons. It is neutral to moderately alkaline.

The C horizon is sandy loam, fine sandy loam, loamy sand, or loam and has strata of sand and gravel. It is neutral to moderately alkaline.

Colwood series

The Colwood series consists of deep, very poorly drained soils. Colwood soils formed in stratified loamy and sandy material on deltas in areas of former lake beds. Permeability is moderate. The slope is 0 to 2 percent.

Colwood soils commonly are adjacent to Dixboro and Sisson soils. They are similar to Gilford, Lamson, Lenawee, and Mermill soils. Dixboro soils do not have a mollic epipedon and colors of low chroma in the subsoil. Sisson soils have an ochric epipedon and are better drained than Colwood soils. Gilford soils have more sand. Lamson, Lenawee, and Mermill soils have a thinner dark surface layer than Colwood soils. Lamson soils have more sand, and Lenawee soils have more clay. Mermill soils have fine-textured material within a depth of 40 inches.

Typical pedon of Colwood loam, about 4 1/2 miles west of Maumee in Monclova Township, 400 feet north and 3,000 feet east of the southwest corner of sec. 31, T. 2.

Ap—0 to 10 inches; black (10YR 2/1) loam; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—10 to 12 inches; black (10YR 2/1) loam; weak medium granular structure; friable; neutral; abrupt wavy boundary.

B21g—12 to 18 inches; dark gray (10YR 4/1) loam; common medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; friable; common medium distinct black (10YR 2/1) organic stains; neutral; gradual wavy boundary.

B22g—18 to 24 inches; grayish brown (2.5Y 5/2) loam; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine distinct very dark gray (10YR 3/1) concretions of iron and manganese oxides; mildly alkaline; abrupt wavy boundary.

B23g—24 to 32 inches; grayish brown (2.5Y 5/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) and dark grayish brown (2.5Y 4/2) mottles; moderate medium subangular blocky structure; firm; few fine distinct very dark gray (10YR 3/1) concretions of iron and manganese oxides; mildly alkaline; gradual wavy boundary.

B3g—32 to 45 inches; grayish brown (2.5Y 5/2) loam; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common fine distinct black (10YR 2/1) concretions of iron and manganese oxides; mildly alkaline; abrupt smooth boundary.

C—45 to 60 inches; mottled gray (5Y 5/1), dark brown (10YR 4/3), and yellowish brown (10YR 5/4) stratified silt loam and fine sand; a few strata of silty clay loam about 1/2 inch thick; friable; strong effervescence; moderately alkaline.

The solum is 35 to 50 inches thick. The depth to free carbonates is 35 to 45 inches. The subsoil is 18 to 35 percent clay.

The A horizon is 10 to 15 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is slightly acid to mildly alkaline.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is loam, sandy clay loam, silty clay loam, and silt loam and has thin subhorizons of silt, very fine sand, and silty clay.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is stratified silt loam, fine sand, very fine sand, silt, and silty clay loam.

Del Rey series

The Del Rey series consists of deep, somewhat poorly drained soils on outwash plains and deltas in areas of former lake beds. Del Rey soils formed in silty clay loam and silty clay lacustrine material underlain by stratified silt loam and silty clay loam. Permeability is slow. The slope is 0 to 3 percent.

Del Rey soils commonly are adjacent to Lenawee soils and are similar to Fulton, Dixboro, and Nappanee soils. Lenawee soils have a dark surface layer and are grayer than Del Rey soils. Fulton soils have more clay and are underlain by silty clay and silty clay loam. Dixboro soils have less clay than Del Rey soils. Nappanee soils formed in glacial till and have more gravel.

Typical pedon of Del Rey loam, 0 to 3 percent slopes, about 2 1/2 miles west of the Toledo city limits in Springfield Township, 960 feet south and 75 feet west of the center of sec. 21, T. 2.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate fine granular structure; firm; common fine roots; medium acid; abrupt smooth boundary.

B21t—8 to 12 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; slightly acid; gradual wavy boundary.

B22t—12 to 17 inches; brown (10YR 4/3) silty clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; firm; thin patchy dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; common fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; few fine roots; slightly acid; gradual wavy boundary.

B23t—17 to 24 inches; brown (10YR 4/3) silty clay; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; thin continuous dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; common fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; few fine roots; slightly acid; gradual wavy boundary.

B24tg—24 to 34 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct brown (10YR 4/3) and yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; common fine distinct very dark brown (10YR 2/2) concretions; neutral; abrupt wavy boundary.

Cg—34 to 60 inches; grayish brown (2.5Y 5/2) silt loam, common medium distinct yellowish brown (10YR 5/6) and olive (5Y 5/3) mottles; thin strata of brown (10YR 4/3) silty clay loam and silty clay; friable; strong effervescence; moderately alkaline.

The solum is 30 to 48 inches thick. The depth to carbonates is 26 to 42 inches. The average clay content in the control section ranges from 35 to 42 percent.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is loam or silt loam and is medium acid to neutral.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It ranges from clay loam to clay. The B horizon is slightly acid to neutral. In some pedons, the lower part of the B horizon is moderately alkaline and has free carbonates.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is stratified silt loam, silty clay loam, very fine sand, and silty clay. In some pedons, the C horizon is underlain by strata of fine and medium sand.

Digby series

The Digby series consists of deep, somewhat poorly drained soils on outwash plains, terraces, and beach ridges. Digby soils formed in loamy material 20 to 40 inches thick over stratified gravelly and sandy material. Permeability is moderate in the loamy material and rapid in the substratum. The slope ranges from 0 to 6 percent.

Digby soils commonly are adjacent to Colwood soils and are similar to Haskins and Dixboro soils. Unlike Digby soils, Colwood soils have a mollic epipedon. Haskins soils commonly have clayey material within a depth of 40 inches. Dixboro soils have more silt and very fine sand in the solum and have a dark surface layer.

Typical pedon of Digby sandy loam, 0 to 2 percent slopes, about 3/4 mile southeast of the Reynolds School in Swan Creek Metropark, 500 feet south and 1,650 feet east of the intersection of Eastgate Road and Airport Highway:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 5/3) loam; common medium distinct yellowish brown (10YR 5/8) and light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; few fine roots; 2 percent small gravel; strongly acid; clear smooth boundary.

B21tg—12 to 18 inches; grayish brown (10YR 5/2) sandy clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; thin patchy grayish brown (10YR 5/2) clay films; 2 percent fine gravel; strongly acid; abrupt smooth boundary.

B22tg—18 to 21 inches; light brownish gray (2.5Y 5/2) sandy loam; common large distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; thin patchy grayish brown (10YR 5/2) clay films, dark brown (7.5YR 4/4) stains; 2 percent fine gravel; medium acid; abrupt smooth boundary.

B23t—21 to 29 inches; yellowish brown (10YR 5/4) sandy clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin patchy grayish brown (10YR 5/2) clay films; common fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; 2 percent fine gravel; slightly acid; clear wavy boundary.

B31g—29 to 34 inches; light brownish gray (2.5Y 6/2) sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; few fine roots; some clay bridging between sand grains; many fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; 5 percent fine gravel; neutral; clear smooth boundary.

B32—34 to 40 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct light brownish gray (2.5Y 6/2) mottles; weak coarse subangular blocky structure; friable; many fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; 5 percent fine gravel; neutral; clear smooth boundary.

IIC1g—40 to 48 inches; gray (5Y 5/1) stratified loamy sand and sandy loam; massive; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

IIC2g—48 to 60 inches; grayish brown (2.5Y 5/2) sand; single grained; very friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 26 to 43 inches. Gravel makes up 2 to 10 percent of the solum and 2 to 15 percent of the substratum.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is medium acid to neutral. In wooded areas, there is an A1 horizon 1 to 3 inches thick that has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam, sandy clay loam, sandy loam, and clay loam. In some pedons, it has thin subhorizons of loamy sand. The B horizon is very strongly acid to slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is loamy sand, sandy loam, and sand. The soil generally is moderately alkaline; in some pedons, it is mildly alkaline.

Dixboro series

The Dixboro series consists of deep, somewhat poorly drained soils. Dixboro soils formed in stratified silty and sandy material on outwash plains and deltas. Permeability is moderate. The slope is 0 to 2 percent.

Dixboro soils commonly are adjacent to Lamson and Sisson soils. They are similar to Bixler, Del Rey, Rimer, and Tedrow soils. Lamson soils have a grayer subsoil than Dixboro soils. Bixler soils have 20 to 35 inches of sandy and loamy material underlain by stratified lacustrine material. Del Rey soils have more clay than Dixboro soils and do not have a dark surface layer. Rimer soils have 20 to 32 inches of sandy and loamy material underlain by fine and moderately fine textured material. Tedrow soils are sandy throughout. Sisson soils have brighter colors below the surface layer than Dixboro soils and do not have a mollic surface.

Typical pedon of Dixboro fine sandy loam, 0 to 2 percent slopes, about 1/2 mile east of Swanton in Swanton Township, 2,240 feet north and 600 feet east of the southwest corner of sec. 5, T. 7 N., R. 9 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A2—9 to 16 inches; grayish brown (10YR 5/2) fine sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; neutral; clear smooth boundary.

B21t—16 to 22 inches; brown (10YR 5/3) fine sandy loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; thin very patchy clay films on vertical faces of peds; neutral; clear smooth boundary.

B22t—22 to 27 inches; yellowish brown (10YR 5/4) fine sandy loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; thin patchy clay films on vertical faces of peds; mildly alkaline; abrupt smooth boundary.

C1—27 to 43 inches; grayish brown (10YR 5/2) stratified fine sand and silt loam; common medium distinct light olive brown (2.5Y 5/4), gray (10YR 5/1), and yellowish brown (10YR 5/6) mottles; massive; friable; mildly alkaline; slight effervescence; abrupt smooth boundary.

C2—43 to 60 inches; grayish brown (10YR 5/2) stratified fine sand and silt loam; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

The thickness of the solum and the depth to free carbonates range from 24 to 40 inches. The average clay content in the argillic horizon is less than 18 percent.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is medium acid to neutral. Pedons in wooded areas have an A1 horizon 2 to 4 inches thick that has hue of 10YR, value of 2, and chroma of 1 or 2.

The B horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam, loam, silt loam, very fine sandy loam, and loamy very fine sand. The B horizon is medium acid to mildly alkaline.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4. It is stratified fine sand, very fine sand, silt loam, and very fine sandy loam. In some pedons, it has thin strata of clay loam or silty clay. The C horizon is mildly alkaline or moderately alkaline.

Dunbridge series

The Dunbridge series consists of moderately deep, well drained soils on outwash plains and till plains. Dunbridge soils formed in sandy and loamy material 20 to 40 inches thick over limestone bedrock. Permeability is moderately rapid. The slope ranges from 0 to 4 percent.

Dunbridge soils commonly are adjacent to Ottokee and Spinks soils and are similar to Seward soils. Unlike Dunbridge soils, Ottokee and Spinks soils do not have a lithic contact within a depth of 40 inches and have more sand in the solum. Seward soils are sandy in the surface layer and the upper part of the subsoil and are clayey in the lower part of the subsoil and in the substratum; they do not have a lithic contact.

Typical pedon of Dunbridge sandy loam, 0 to 4 percent slopes, in Waterville, 2,800 feet north and 542 feet east of the northern intersection of River Road and OH-64:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam; moderate fine granular structure; few fine pebbles; friable; many fine roots; neutral; abrupt smooth boundary.

B1—8 to 14 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; few fine roots; few medium distinct dark brown (10YR 3/3) organic stains; 2 percent gravel; neutral; abrupt wavy boundary.

B2t—14 to 25 inches; reddish brown (5YR 4/3) gravelly sandy clay loam; moderate medium subangular blocky structure parting to medium fine subangular blocky; firm; few fine roots; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds; 15 percent gravel and fractured limestone; clay coatings on gravel and clay bridging between sand grains; mildly alkaline; abrupt smooth boundary.

IICr—25 to 27 inches; light gray (10YR 7/2) weathered and fractured limestone; common thick distinct dark brown (7.5YR 4/4) clay coatings on rock fragments; strong effervescence; moderately alkaline.

IIR—27 to 29 inches; light gray (10YR 7/2) limestone bedrock; strong effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The depth to free carbonates is 20 to 34 inches. Gravel and limestone fragments make up 1 to 15 percent of the solum.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3.

The B1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is light sandy loam or fine sandy loam and is slightly acid to mildly alkaline.

The B2t horizon has hue of 5YR to 10YR, value of 4, and chroma of 3 to 5. It is sandy clay loam, clay loam, or sandy loam and the gravelly phases of these textures. The B2t horizon is neutral to mildly alkaline.

The IICr horizon has hue of 10YR, value of 5 to 7, and chroma of 2 or 3. It consists of partly weathered and fractured limestone. The limestone is moderately alkaline and strongly effervescent.

The limestone bedrock has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 to 3.

Eel series

The Eel series consists of deep, moderately well drained soils that formed in loamy recent alluvium on flood plains. Permeability is moderate. The slope is 0 to 2 percent.

Eel soils commonly are adjacent to Shoals and Sloan soils and are similar to Ross soils. Shoals soils have dominantly low chroma colors in the control section. Sloan soils are dominantly gray immediately below the mollic epipedon. Ross soils have thick, dark surface and subsurface layers.

Typical pedon of Eel loam, occasionally flooded, about 1 mile southeast of Albon Lake in Monclova Township, 600 feet north and 900 feet east of the center of sec. 33, T. 2.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.
B21—9 to 16 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; neutral; abrupt wavy boundary.
B22—16 to 22 inches; yellowish brown (10YR 5/4) loam; few fine distinct dark brown (10YR 4/3) and grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.
B3—22 to 33 inches; dark yellowish brown (10YR 4/4) loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.
C—33 to 60 inches; dark brown (10YR 4/3) sandy loam that has strata of loamy sand; common medium faint dark grayish brown (10YR 4/2) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum is 25 to 44 inches thick. The depth to free carbonates is 32 to 40 inches. The average clay content in the control section ranges from 18 to 25 percent. The solum is neutral to moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3.

The upper part of the B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly loam or silt loam but can range from heavy sandy loam to light silty clay loam. The lower part of the B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is sandy loam to silty clay loam, and there are strata of sandy and gravelly material.

Fulton series

The Fulton series consists of deep, somewhat poorly drained soils that formed in clayey, lake-laid sediment on lake plains and deltas. Permeability is very slow. The slope ranges from 0 to 6 percent.

Fulton soils commonly are adjacent to Latty and Toledo soils. They are similar to Del Rey and Nappanee soils. Latty and Toledo soils have a grayer subsoil than Fulton soils, and Toledo soils have a darker surface layer. Del Rey soils have less clay in the subsoil and are underlain by stratified silt loam and silty clay loam. Unlike Fulton soils, Nappanee soils formed in glacial till and have coarse fragments.

Typical pedon of Fulton silty clay loam, 0 to 2 percent slopes, about 2 miles northwest of Bono in Jerusalem Township, 1,000 feet south and 750 feet east of the northwest corner of sec. 1, T. 10 S., R. 9 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine angular blocky structure; firm; common fine roots; slightly acid; abrupt smooth boundary.
B21tg—9 to 15 inches; gray (10YR 5/1) silty clay; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine angular blocky structure; very firm; few medium distinct very dark gray (10YR 3/1) stains; few fine roots; thin patchy dark gray (10YR 4/1) clay films on faces of peds; slightly acid; abrupt smooth boundary.
B22t—15 to 23 inches; brown (10YR 5/3) silty clay; common medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; very firm; thin patchy gray (10YR 5/1) clay films on faces of peds; few fine roots; neutral; abrupt wavy boundary.
B23t—23 to 32 inches; yellowish brown (10YR 5/4) silty clay; common to many medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; thin patchy gray (10YR 5/1) clay films on vertical faces of peds; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; few fine roots; mildly alkaline; clear wavy boundary.
B3g—32 to 39 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak medium platy; very firm; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; slight effervescence; mildly alkaline; clear wavy boundary.
C—39 to 60 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct dark gray (10YR 4/1) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium platy structure due to stratification; very firm; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; strong effervescence; moderately alkaline.

The solum is 24 to 44 inches thick. The depth to free carbonates is 24 to 40 inches. The clay content of the individual layers within the subsoil is 42 to 55 percent. The average clay content in the control section is more than 45 percent.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is strongly acid to neutral.

The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 4. It is mottled silty clay or clay. In some pedons, it has a few thin strata of silty clay loam, silt loam, silt, or fine sand. The B horizon is strongly acid to mildly alkaline.

The C horizon is silty clay or clay. In some pedons it has thin strata of silty clay loam, silt loam, or fine sand. The C horizon is massive and has vertical partings and platiness due to stratification.

Gilford series

The Gilford series consists of deep, very poorly drained soils that formed in loamy and sandy material on outwash plains, beach ridges, and deltas. Permeability is moderately rapid. The slope is 0 to 2 percent.

Gilford soils commonly are adjacent to Ottokee and Tedrow soils. They are similar to Colwood, Granby, Lamson, Mermill, and Wauseon soils. Ottokee soils have better drainage than Gilford soils, and they have mottles of low chroma in the lower part of the subsoil. Tedrow soils have better drainage and do not have a mollic epipedon. Colwood soils have more clay and silt in the control section than Gilford soils. Granby soils have more sand in the control section. Lamson soils have more silt and, unlike Gilford soils, are underlain by stratified silt loam and very fine sand. Mermill soils have more clay than Gilford soils. Wauseon soils have more clay in the substratum.

Typical pedon of Gilford fine sandy loam, in Secor Park, Toledo Metro System, in Richfield Township, 1,200 feet south of the center of sec. 26, T. 9 S., R. 5 E.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam; weak medium granular structure; very friable; common fine roots, many medium roots; slightly acid; clear smooth boundary.

A12—9 to 14 inches; very dark gray (10YR 3/1) fine sandy loam; few fine distinct yellowish brown (10YR 5/6) and few fine faint gray (10YR 5/1) mottles; weak medium subangular blocky structure; very friable; common fine roots; slightly acid; clear wavy boundary.

B21g—14 to 21 inches; gray (10YR 5/1) fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; slightly acid; clear wavy boundary.

B22g—21 to 28 inches; gray (10YR 5/1) fine sandy loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; slightly acid; few very dark gray (10YR 3/1) organic stains; clear wavy boundary.

B23g—28 to 37 inches; gray (10YR 6/1) loamy fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.

Cg—37 to 60 inches; gray (10YR 6/1) loamy fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; strong effervescence; moderately alkaline.

The solum is 26 to 44 inches thick. The depth to carbonates is 30 to 44 inches. Coarse fragments make up 0 to 5 percent of the solum and 0 to 15 percent of the substratum. The mollic epipedon is 10 to 15 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is slightly acid or neutral.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It generally is fine sandy loam or sandy loam; the subhorizons range from loamy sand to light clay loam. The B horizon is slightly acid or neutral.

The C horizon has hue of 10YR to 2.5Y, value of 4 to 6, and chroma of 0 to 6. It is stratified fine sand to sandy loam.

Granby series

The Granby series consists of deep, very poorly drained soils that formed in sandy material on postglacial outwash plains and lake plains. Permeability is rapid. The slope is 0 to 2 percent.

Granby soils commonly are adjacent to Oakville, Ottokee, Spinks, and Tedrow soils. They are similar to Gilford and Lamson soils. Unlike Granby soils, Oakville and Spinks soils are well drained and have an ochric epipedon. Ottokee soils are moderately well drained and have an ochric epipedon. Tedrow soils are somewhat poorly drained, have an ochric epipedon, and have colors of brighter chroma in the B horizon. Gilford soils have more clay than Granby soils. Lamson soils have a thinner dark surface layer, have more clay, and are underlain mainly by stratified very fine sand.

Typical pedon of Granby loamy fine sand, about 1 3/4 miles north of Whitehouse in Monclova Township, 600 feet north and 25 feet east of the southwest corner of sec. 23, T. 7 N., R. 9 E.

Ap—0 to 8 inches; black (10YR 2/1) loamy fine sand; weak medium granular structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) loamy fine sand; weak medium subangular blocky structure; very friable; common fine roots; slightly acid; abrupt wavy boundary.

B2g—12 to 19 inches; dark gray (10YR 4/1) fine sand; very weak medium subangular blocky structure; very friable; few fine roots; common coarse distinct very dark grayish brown (10YR 3/2) stains; slightly acid; gradual wavy boundary.

B3g—19 to 27 inches; grayish brown (2.5Y 5/2) fine sand; single grained; loose; few fine distinct yellowish brown (10YR 5/4) mottles; few fine roots; common coarse distinct very dark grayish brown (10YR 3/2) stains; slightly acid; gradual wavy boundary.

Cg—27 to 60 inches; light brownish gray (10YR 6/2) fine sand; single grained; loose; common medium distinct dark grayish brown (10YR 4/2) and few medium distinct light olive brown (2.5Y 5/4) mottles; neutral.

The solum is 24 to 42 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It has a high organic matter content. The A horizon is 10 to 16 inches thick. It is medium acid to neutral.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is fine sand, sand, or loamy fine sand and is medium acid to neutral.

The C horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 to 4. It is sand or fine sand and is neutral to moderately alkaline.

Haskins series

The Haskins series consists of deep, somewhat poorly drained soils on outwash plains, terraces, and beach ridges. Haskins soils formed in loamy material 20 to 40 inches thick over fine-textured till or lacustrine material. Permeability is moderate in the loamy material and slow or very slow in the underlying material. The slope is 0 to 3 percent.

Haskins soils commonly are adjacent to Mermill soils. They are similar to Digby, Dixboro, and Metamora soils. Unlike Haskins soils, Mermill soils have a dark surface layer. Digby soils are underlain by sandy material. Dixboro soils are underlain by loamy and sandy material. Digby and Dixboro soils do not have fine-textured material within a depth of 40 inches. Metamora soils have a dark surface layer.

Typical pedon of Haskins loam, 0 to 3 percent slopes, about 1 1/2 miles northeast of Richfield Center in Richfield Township, 2,800 feet north and 1,310 feet east of the southwest corner of sec. 11, T. 9 S., R. 5 E.

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

B21t—9 to 14 inches; brown (10YR 5/3) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common medium distinct very dark gray (10YR 3/1) stains; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 2 percent gravel; slightly acid; abrupt smooth boundary.

B22gt—14 to 20 inches; grayish brown (10YR 5/2) sandy clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; clay bridging between sand grains; 3 percent gravel; slightly acid; abrupt wavy boundary.

B23t—20 to 23 inches; dark yellowish brown (10YR 4/4) sandy loam; common fine distinct grayish brown (10YR 5/2) mottles; very weak fine subangular blocky structure; friable; dark grayish brown (10YR 4/2) clay bridgings between sand grains; 2 percent gravel; neutral; abrupt smooth boundary.

IIB3t—23 to 28 inches; grayish brown (10YR 5/2) clay; common medium distinct dark yellowish brown (10YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; 2 percent gravel; mildly alkaline; abrupt smooth boundary.

IIC—28 to 60 inches; grayish brown (10YR 5/2) clay; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; massive; very firm; 4 percent gravel; light gray (10YR 6/1) stains on cleavage plains; strong effervescence; moderately alkaline.

The solum is 25 to 45 inches thick. Typically, it extends into the underlying fine-textured material. Gravel makes up 2 to 10 percent of the soil in the upper part of the solum and 0 to 8 percent in the lower part of the solum and the underlying material.

The A horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is strongly acid to neutral.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is sandy loam to clay loam. The B horizon is strongly acid to slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

The IIB horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 0 to 3. It is clay, fine clay loam, or silty clay and is neutral to moderately alkaline.

The IIC horizon has hue of 10YR to 5YR, value of 4 to 6, and chroma of 1 to 3. It is fine clay loam, clay, or silty clay.

Hoytville series

The Hoytville series consists of deep, very poorly drained soils on till plains in areas of former lake beds. Hoytville soils formed in clay loam and clay glacial till that has been modified by water action in the upper part. Permeability is moderately slow in the subsoil and slow in the substratum. The slope is 0 to 2 percent.

Hoytville soils commonly are adjacent to Nappanee and St. Clair soils and are similar to Latty, Lenawee, and Toledo soils. Nappanee soils are less gray in the subsoil than Hoytville soils and do not have a dark surface layer. Unlike Hoytville soils, St. Clair soils do not have a dark surface layer and dominantly gray colors in the subsoil. Latty soils have neither a dark surface layer nor coarse fragments. Lenawee soils have less clay and do not have coarse fragments. Toledo soils do not have coarse fragments and are underlain by stratified silty clay and silty clay loam.

Typical pedon of Hoytville clay loam, about 1/2 mile north of Richfield Center in Richfield Township, 2,350 feet north and 165 feet west of the southeast corner of sec. 16, T. 9 S., R. 5 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) clay loam; moderate medium angular blocky structure; firm; common fine roots; 1 percent coarse fragments; slightly acid; abrupt smooth boundary.

B21tg—9 to 17 inches; dark grayish brown (10YR 4/2) clay; few medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; common medium distinct yellowish brown (10YR 5/6) mottles; firm; common medium distinct yellowish brown (10YR 5/6) mottles; thin patchy clay films on vertical and horizontal faces of peds; common fine roots; 1 percent coarse fragments; few fine distinct stains of iron and manganese oxides; slightly acid; diffuse smooth boundary.

B22tg—17 to 26 inches; dark grayish brown (10YR 4/2) clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; common medium distinct dark yellowish brown (10YR 4/4) mottles; few fine roots; 1 to 2 percent coarse fragments; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; thin patchy dark gray (10YR 4/1) clay films on vertical and horizontal faces of peds; slightly acid; clear wavy boundary.

B23tg—26 to 34 inches; dark grayish brown (10YR 4/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; very firm; common medium distinct yellowish brown (10YR 5/6) and dark brown (10YR 4/3) mottles; 2 percent coarse fragments; common medium distinct black (10YR 2/1) concretions; thin patchy dark gray (10YR 4/1) clay films on vertical and horizontal faces of peds; few fine roots; neutral; clear wavy boundary.

B3tg—34 to 45 inches; dark grayish brown (10YR 4/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure; very firm; 2 percent coarse fragments; clay films on vertical faces of peds; few fine roots; neutral; clear smooth boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4) clay; common medium distinct dark grayish brown (10YR 4/2) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; very firm; 2 to 3 percent coarse fragments; light gray (10YR 7/2) segregations of secondary carbonates; strong effervescence; moderately alkaline.

The solum is 36 to 54 inches thick. The depth to free carbonates is 32 to 54 inches. Coarse fragments make up 2 to 10 percent of the solum and substratum.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is clay or clay loam and is slightly acid to neutral. Pedons in wooded areas have an A1 horizon 2 to 5 inches thick that has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay or silty clay. In some pedons, it has thin subhorizons of silty clay loam or clay loam. The B horizon is slightly acid to mildly alkaline.

The C horizon is clay or clay loam.

Lamson series

The Lamson series consists of deep, very poorly drained soils that formed in stratified loamy and sandy water-laid material on outwash plains and deltas. Permeability is moderately rapid. The slope is 0 to 2 percent.

Lamson soils commonly are adjacent to Bixler and Dixboro soils and are similar to Gilford, Mermill, and Wauseon soils. Bixler soils are more sandy than Lamson soils and have brighter colors in the subsoil. Unlike Lamson soils, Dixboro soils have an argillic horizon and are not gray immediately below the surface layer. Gilford soils have a mollic epipedon. Mermill soils are underlain by fine-textured material and have more clay in the control section than Lamson soils. Wauseon soils have a mollic epipedon and are underlain by fine or moderately fine textured material.

Typical pedon of Lamson fine sandy loam, about 1/2 mile southeast of Swanton in Swanton Township, 2,200 feet north and 1,300 feet east of the southwest corner of sec. 7, T. 7 N., R. 9 E.

Ap—0 to 9 inches; very dark brown (10YR 2/2) fine sandy loam; weak fine granular structure; friable; many fine roots, few medium roots; medium acid; abrupt smooth boundary.

B1g—9 to 20 inches; grayish brown (10YR 5/2) very fine sandy loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; common medium distinct very dark gray (10YR 3/1) organic stains; many fine roots, few medium roots; slightly acid; gradual wavy boundary.

B21g—20 to 33 inches; grayish brown (10YR 5/2) very fine sandy loam; many medium distinct yellowish brown (10YR 5/4) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; very dark gray (10YR 3/1) stains coating old root channels; few fine and medium roots; neutral; gradual wavy boundary.

B22—33 to 40 inches; yellowish brown (10YR 5/6) loam; many medium distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; very dark gray (10YR 3/1) organic stains coating root channels; few fine distinct very dark grayish brown (10YR 3/2) concretions of iron and manganese oxides; mildly alkaline; gradual wavy boundary.

B23g—40 to 46 inches; grayish brown (2.5Y 5/2) loam; many medium distinct yellowish brown (10YR 5/6) and few fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few fine distinct very dark grayish brown (10YR 3/2) concretions of iron and manganese oxides; very dark gray (10YR 3/1) coatings on old root channels; mildly alkaline; abrupt smooth boundary.

C—46 to 60 inches; grayish brown (2.5Y 5/2) very fine sand; 1/4 inch bands of silty material; common large distinct yellowish brown (10YR 5/4) and gray (10YR 6/1) mottles; single grained; loose; few medium distinct dark reddish brown (5YR 2/2) stains; strong effervescence; moderately alkaline.

The solum is 32 to 48 inches thick. The depth to free carbonates is 32 to 54 inches. The average clay content in the control section is less than 18 percent.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is medium acid to neutral. Pedons in wooded areas have an A1 horizon 2 to 5 inches thick that has hue of 10YR, value of 2, and chroma of 1 or 2.

The B horizon has hue of 10YR to 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is fine sandy loam, very fine sandy loam, loam, and silt loam and has thin subhorizons of loamy very fine sand or loamy fine sand. The B horizon is medium acid to mildly alkaline.

The C horizon has hue of 10YR to 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is stratified fine sand, very fine sand, silt, silt loam, and very fine sandy loam. In some pedons, there are thin strata of clay loam or silty clay. The C horizon is neutral to moderately alkaline.

Latty series

The Latty series consists of deep, very poorly drained soils that formed in clayey lacustrine sediment on lake plains. Permeability is very slow. The slope is 0 to 2 percent.

Latty soils commonly are adjacent to Fulton soils and are similar to Hoytville, Lenawee, and Toledo soils. Unlike Latty soils, Fulton soils do not have at least one subhorizon in the subsoil that has a dominant color of low chroma. Hoytville soils have a dark surface layer and some gravel. Lenawee soils have a dark surface layer, have less clay, and are underlain by stratified silt loam and silty clay loam. Toledo soils have a dark surface layer and are underlain by silty clay and silty clay loam.

Typical pedon of Latty silty clay, about 1/4 mile west of Bono in Jerusalem Township, 2,250 feet south and 200 feet west of the northeast corner of sec. 7, T. 10 S., R. 10 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay; (10YR 4/2, rubbed); moderate medium subangular blocky structure; firm; many fine roots; slightly acid; abrupt smooth boundary.

B21g—10 to 18 inches; gray (5Y 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) and dark brown (7.5YR 4/4) mottles; moderate fine angular blocky structure; firm; few very dark grayish brown (10YR 3/2) organic stains; few fine distinct very dark gray (10YR 3/1) concretions of iron and manganese oxides; few fine roots; neutral; clear wavy boundary.

B22g—18 to 27 inches; gray (5Y 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; neutral; clear wavy boundary.

B23g—27 to 33 inches; gray (5Y 5/1) silty clay; common fine distinct yellowish brown (10YR 5/4) and common medium distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; common fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; few fine roots; neutral; gradual wavy boundary.

B3g—33 to 46 inches; gray (5Y 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; dark yellowish brown (10YR 4/4) on ped interiors; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; few fine roots; neutral; abrupt wavy boundary.

Cg—46 to 65 inches; gray (5Y 5/1) silty clay; many medium distinct yellowish brown (10YR 5/4) and common medium distinct light olive brown (2.5YR 5/4) mottles; massive; firm; common medium distinct light gray (10YR 7/1) concretions of lime; strong effervescence; moderately alkaline.

The solum is 36 to 58 inches thick. The depth to carbonates is 36 to 50 inches. There are no coarse fragments in the solum. The substratum is 0 to 10 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is slightly acid or neutral. Pedons in wooded areas have an A1 horizon 3 to 5 inches thick that has hue of 10YR, value of 3 or 4, and chroma of 1.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay or silty clay and is neutral to moderately alkaline.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is stratified clay and silty clay and commonly has a few thin strata of silty clay loam or silt loam.

Lenawee series

The Lenawee series consists of deep, very poorly drained soils on outwash plains and deltas. Lenawee soils formed in silty clay and silty clay loam material underlain by stratified silt loam and silty clay loam. Permeability is moderately slow. The slope is 0 to 2 percent.

Lenawee soils commonly are adjacent to Del Rey soils and are similar to Colwood, Hoytville, Latty, Mermill, and Toledo soils. Del Rey soils do not have a dark surface layer. Colwood soils have less clay than Lenawee soils and have a mollic epipedon. Unlike Lenawee soils, Hoytville soils formed in glacial till and have coarse fragments. Latty soils do not have a dark surface layer and have more clay. Mermill soils have more sand in the upper part of the subsoil and more clay in the lower part of the subsoil and in the substratum than Lenawee soils. Toledo soils have more clay in the subsoil and are underlain by silty clay.

Typical pedon of Lenawee silty clay loam, about 5 miles west of Maumee in Monclova Township, 1,620 feet south and 1,140 feet east of the northwest corner of sec. 31, T. 2.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium granular structure; firm; common fine roots; slightly acid; abrupt smooth boundary.

B21g—9 to 18 inches; grayish brown (2.5Y 5/2) silty clay; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate medium subangular blocky structure; firm; dark gray (10YR 4/1) faces of peds; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; common fine roots; neutral; gradual wavy boundary.

B22g—18 to 27 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) mottles; moderate medium angular blocky structure parting to weak fine angular blocky; very firm; gray (10YR 5/1) faces of peds; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; few fine roots; neutral; gradual wavy boundary.

B23g—27 to 38 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very firm; gray (10YR 5/1) faces of peds; common fine distinct black (10YR 2/1) concretions of iron and manganese oxides; few fine roots; mildly alkaline; gradual wavy boundary.

B3g—38 to 45 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very firm; gray (5Y 5/1) faces of peds; common fine distinct black (10YR 2/1) concretions of iron and manganese oxides; mildly alkaline; clear wavy boundary.

Cg—45 to 60 inches; olive gray (5Y 5/2) stratified silty clay loam and silt loam; many medium distinct yellowish brown (10YR 5/6, 5/8) and few fine distinct greenish gray (5BG 6/1) mottles; massive; firm; moderately alkaline; strong effervescence.

The solum is 30 to 50 inches thick. The depth to free carbonates is 30 to 65 inches. The average clay content in the subsoil ranges from 35 to 45 percent.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is medium acid to neutral.

The B horizon has hue of 10YR, 5Y, or 2.5Y; value of 4 to 6; and chroma of 1 or 2. It is clay loam, silty clay loam, and silty clay and is medium acid to mildly alkaline.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is stratified silty clay, silty clay loam, clay loam, and silt loam. In some pedons, there are thin strata of sand.

Mermill series

The Mermill series consists of deep, very poorly drained soils on outwash plains, terraces, and beach ridges. Mermill soils formed in loamy material 20 to 40 inches thick over fine-textured till or lacustrine material. Permeability is moderate in the loamy material and slow or very slow in the clayey material. The slope is 0 to 2 percent.

Mermill soils commonly are adjacent to Haskins and Metamora soils. They are similar to Colwood, Gilford, Lamson, Lenawee, and Wauseon soils. Unlike Mermill soils, Haskins soils have an ochric epipedon and a low chroma matrix in the subsoil. Metamora soils are somewhat poorly drained and are less gray in the subsoil. Colwood soils have a mollic epipedon and are underlain by stratified loamy and sandy material. Gilford soils have a mollic epipedon and more sand than Mermill soils. Lamson soils have more sand and are underlain by stratified silt and very fine sand. Lenawee soils have more clay than Mermill soils. Wauseon soils have a mollic epipedon and have less clay in the control section.

Typical pedon of Mermill loam in an area of Mermill-Urban land complex, in Toledo, 1,400 feet north and 1,000 feet east of the junction of Cass Road and Heather Downs Boulevard:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam; weak fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

B21tg—8 to 14 inches; dark grayish brown (10YR 4/2) loam; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; weak medium subangular blocky structure; thin continuous dark gray (10YR

3/1) stains; many fine roots; slightly acid; clear smooth boundary.

B22tg—14 to 19 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy dark gray (10YR 4/1) clay films on faces of peds; few very dark gray (10YR 3/1) stains; few fine roots; neutral; clear smooth boundary.

B23tg—19 to 23 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; weak medium subangular blocky structure; thin patchy gray (10YR 5/1) clay films on faces of peds; firm; black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual wavy boundary.

IIB3g—23 to 31 inches; grayish brown (10YR 5/2) clay; many medium distinct yellowish brown (10YR 5/4, 5/6) mottles; weak medium subangular blocky structure; firm; black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual wavy boundary.

IIC—31 to 60 inches; grayish brown (10YR 5/2) clay loam; many medium distinct yellowish brown (10YR 5/4, 5/6) and few medium distinct gray (5Y 5/1) mottles; massive; black (10YR 2/1) concretions of iron and manganese oxides; firm; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 48 inches. The depth to the fine-textured subsoil is 20 to 40 inches. Gravel makes up 0 to 10 percent of the solum above the subsoil. Reaction in this part of the solum is slightly acid to neutral. The lower part of the solum, which formed in fine or moderately fine textured material, is neutral to moderately alkaline. The finer textured material is more than 35 percent clay.

The A horizon is less than 10 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It ranges from sandy loam to clay loam.

The IIB horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2.

The IIC horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. It ranges from clay loam to silty clay. Pebbles make up 0 to 6 percent of the IIC horizon.

Metamora series

The Metamora series consists of deep, somewhat poorly drained soils on outwash plains and beach ridges. Metamora soils formed in loamy material 20 to 40 inches thick over moderately fine textured till or lacustrine material. Permeability is moderately rapid in the loamy material and moderately slow in the moderately fine textured material. The slope is 0 to 3 percent.

These soils have matrix colors in the B horizon that have chroma of 3. The IIB horizon has matrix colors that have value of 4. These colors are outside the defined range for the Metamora series, but this difference does not affect the use and management of these soils.

Metamora soils commonly are adjacent to Mermill and Wauseon soils. They are similar to Digby, Dixboro, and Haskins soils. Mermill and Wauseon soils are wetter than Metamora soils. Digby soils are underlain by more clayey soil material. Digby and Haskins soils have an ochric epipedon. Dixboro soils are coarser textured than Metamora soils and are underlain by loamy and sandy material.

Typical pedon of Metamora sandy loam, 0 to 3 percent slopes, 1/2 mile northwest of Richfield Center in Richfield Township, 1,600 feet north and 2,250 feet west of the southeast corner of sec. 16, T. 9 S., R. 5 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam; moderate medium granular structure; friable; many fine roots, few medium roots; slightly acid; 2 percent gravel; abrupt smooth boundary.

B1t—9 to 16 inches; brown (10YR 5/3) sandy loam; common fine distinct yellowish brown (10YR 5/6) and few fine distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; common fine roots; few fine distinct black (10YR 2/1) organic stains; thin patchy gray (10YR 5/1) clay films on vertical faces of peds and clay bridgings between sand grains; slightly acid; 3 percent gravel; clear smooth boundary.

B21tg—16 to 23 inches; dark grayish brown (10YR 4/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) and brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous gray (10YR 5/1) clay films on faces of peds; neutral; 4 percent gravel; clear smooth boundary.

IIB22tg—23 to 31 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy gray (10YR 5/1) clay films on faces of peds; brown (10YR 5/3) faces of peds; neutral; 4 percent gravel; gradual wavy boundary.

IICg—31 to 60 inches; grayish brown (10YR 5/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; massive with cleavage faces; light gray (10YR 7/1) coatings of lime on cleavage faces; firm; 7 percent gravel; moderately alkaline; strong effervescence.

The thickness of the solum and the depth to carbonates range from 20 to 40 inches. The soil is 0 to 8 percent gravel throughout.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is strongly acid to slightly acid.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 3. It is loamy sand, sandy clay loam, or sandy loam and is strongly acid to neutral.

The IIB horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy clay loam, clay loam, or silty clay loam and is slightly acid to mildly alkaline.

The IIC horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is clay loam or silty clay loam.

Muskego series

The Muskego series consists of deep, very poorly drained soils that formed in organic material on outwash plains and deltas. Permeability is moderately slow to moderately rapid in the upper part of the soil and slow in the underlying material. The slope is 0 to 2 percent.

Muskego soils commonly are adjacent to Del Rey soils. Unlike Muskego soils, Del Rey soils formed in mineral material.

Typical pedon of Muskego muck, about 1 1/4 miles northeast of Bono in Jerusalem Township, 650 feet east and 1,000 feet north of the center of sec. 5, T. 10 S., R. 10 E.

Oap—0 to 12 inches; black (N/0) broken face and black (10YR 2/1) rubbed sapric material; about 5 percent fiber, 1 percent rubbed; weak fine granular structure; friable; common fine roots; herbaceous fiber; medium acid; abrupt smooth boundary.

Oa2—12 to 31 inches; dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) broken face sapric material; about 10 percent fiber, 1 percent rubbed; weak medium platy structure; friable; common black (10YR 2/1) organic stains on faces of peds; common medium distinct dark brown (10YR 3/3) mottles; common fine roots; herbaceous fiber; slightly acid; clear wavy boundary.

Oa3—31 to 36 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (2.5YR 4/2) broken face sapric material; about 15 percent fiber, less than 5 percent rubbed; very weak medium platy structure; friable; common black (10YR 2/1) organic stains on faces of peds; herbaceous fiber; neutral; abrupt smooth boundary.

Lco—36 to 60 inches; very dark gray (5Y 3/1) coprogenous earth; common medium faint very dark grayish brown (10YR 3/2) mottles; about 10 percent fiber, 1 percent crushed; massive; slightly plastic; few black (10YR 2/1) organic stains; neutral.

The depth to coprogenous earth is 20 to 42 inches. The fiber content is 0 to 15 percent. Fragments of twigs, branches, and logs make up 0 to 10 percent of the soil.

The surface tier has hue of 10YR, value of 2 or 3, and chroma of 0 to 2. It is sapric material that is medium acid to neutral. Some pedons have hemic material. The Oa2 and Oa3 tiers have hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 0 to 3. They are dominantly sapric material that is medium acid to neutral.

The layer of coprogenous earth has hue of 10YR and 5Y, value of 2 to 5, and chroma of 1 or 2. It ranges from slightly acid to mildly alkaline.

Nappanee series

The Nappanee series consists of deep, somewhat poorly drained soils on till plains in areas of former lake beds. Nappanee soils formed in calcareous glacial till that was modified in the upper part by water action. Permeability is very slow. The slope is 0 to 3 percent.

Nappanee soils commonly are adjacent to Hoytville and St. Clair soils and are similar to Del Rey and Fulton soils. Hoytville soils have a darker surface layer and are grayer in the subsoil than Nappanee soils. St. Clair soils have better drainage and are less gray in the subsoil. Unlike Nappanee soils, Del Rey and Fulton soils formed in lacustrine deposits and do not have coarse fragments.

Typical pedon of Nappanee loam, 0 to 3 percent slopes, about 1 1/2 miles northeast of Richfield Center in Richfield Township, 400 feet north and 2,300 feet west of the southeast corner of sec. 11, T. 9 S., R. 5 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate medium subangular blocky structure; firm; common fine roots; 1 percent gravel; slightly acid; abrupt smooth boundary.

B21t—8 to 19 inches; dark brown (10YR 4/3) clay; common fine distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; very firm; few fine roots; medium continuous dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; 3 percent gravel; slightly acid; clear wavy boundary.

B22t—19 to 25 inches; dark brown (10YR 4/3) clay; common medium distinct dark gray (10YR 4/1) mottles; moderate medium angular blocky structure; very firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; few fine distinct very dark brown (10YR 2/2) concretions of iron and manganese oxides; 3 percent coarse fragments; neutral; clear wavy boundary.

B3tg—25 to 33 inches; dark grayish brown (10YR 4/2) clay; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; very firm; thin very patchy dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; light gray (10YR 7/2) coatings of lime; 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—33 to 60 inches; dark grayish brown (10YR 4/2) clay; common medium distinct dark yellowish brown (10YR 4/4) and few medium distinct yellowish brown (10YR 5/6) mottles; massive; extremely firm; 3 to 5 percent coarse fragments; strong effervescence; moderately alkaline.

The solum is 22 to 38 inches thick. The depth to carbonates is 18 to 36 inches. The average clay content in the control section is more than 45 percent. The soil is medium acid to neutral in the upper part of the solum and slightly acid to moderately alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or silty clay loam. It is 1 to 5 percent coarse fragments.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is 1 to 8 percent coarse fragments.

The C horizon consists of clay or clay loam glacial till. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3.

Oakville series

The Oakville series consists of deep, well drained soils that formed in sandy material on postglacial beach ridges and dunes. Permeability is very rapid. The slope ranges from 2 to 18 percent.

Oakville soils commonly are adjacent to Granby, Ottokee, Spinks, and Tedrow soils. Granby soils have a mollic epipedon and are grayer than Oakville soils. Unlike Oakville soils, Ottokee soils have lamellae and colors that have chroma of 2 within a depth of 40 inches. Spinks soils have an argillic horizon. Tedrow soils have low-chroma colors in the upper part of the subsoil.

Typical pedon of Oakville fine sand, 2 to 6 percent slopes, about 3 miles northwest of Whitehouse in Oak Openings Metropark in Swanton Township, 1,260 feet west and 800 feet north of the center of sec. 21, T. 7 N., R. 9 E.

A11—0 to 2 inches; black (10YR 2/2) fine sand; weak fine granular structure; very friable; many fine and medium roots; medium acid; abrupt wavy boundary.

A12—2 to 6 inches; dark grayish brown (10YR 4/2) fine sand; weak fine granular structure; very friable; many fine roots, few medium roots; medium acid; clear wavy boundary.

B21—6 to 11 inches; dark brown (7.5YR 4/4) fine sand; single grained; loose; very dark grayish brown (10YR 3/2) stains; many fine roots, few medium roots; slightly acid; abrupt smooth boundary.

B22—11 to 18 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; few fine roots; very dark gray (10YR 3/1) stains in old root channels; slightly acid; clear smooth boundary.

B3—18 to 24 inches; brown (10YR 5/3) fine sand; single grained; loose; slightly acid; gradual wavy boundary.

C—24 to 80 inches; pale brown (10YR 6/3) fine sand; single grained; loose; slightly acid.

The solum is 22 to 40 inches thick. The depth to carbonates is more than 60 inches. Gravel makes up 0 to 5 percent of the soil in the solum and substratum.

The A11 horizon is 1 to 4 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A12 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The Ap horizon, if present, has hue of 10YR, value of 3 or 4, and chroma of 1 through 4.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is fine sand or loamy fine sand and is medium acid to neutral.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is slightly acid to moderately alkaline.

Ottokee series

The Ottokee series consists of deep, moderately well drained soils. Ottokee soils formed in sandy material on postglacial beach ridges and dunes. Permeability is rapid. Slopes range from 0 to 6 percent.

Ottokee soils commonly are adjacent to Gilford, Granby, Oakville, Spinks, and Tedrow soils. They are similar to Dunbridge and Seward soils. Gilford and Granby soils have a mollic epipedon and are grayer than Ottokee soils. Oakville and Spinks soils do not have mottles or a matrix chroma of 2 or less within a depth of 40 inches, and Spinks soils have an argillic horizon. Tedrow soils have low-chroma mottles in the upper part of the B horizon. Seward soils are moderately fine or fine textured within a depth of 40 inches. Dunbridge soils have a lithic contact between depths of 20 and 40 inches and have more clay than Ottokee soils.

Typical pedon of Ottokee fine sand, 0 to 6 percent slopes, about 2 1/2 miles northwest of Whitehouse in Swanton Township, 760 feet west and 190 feet north of the center of sec. 29, T. 7 N., R. 9. E.

Ap—0 to 9 inches; dark brown (10YR 4/3) fine sand; weak medium subangular blocky structure; very friable; few medium distinct very dark brown (10YR 2/2) organic stains; thin layer in the lower 2 inches resulting from the mixing of organic matter into the soil; many fine and medium roots; medium acid; abrupt smooth boundary.

B21—9 to 17 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; few fine distinct very dark grayish brown (10YR 3/2) organic stains; common fine and few medium roots; slightly acid; gradual wavy boundary.

B22—17 to 32 inches; yellowish brown (10YR 5/6) fine sand; common fine distinct reddish brown (5YR 5/4) and yellowish red (5YR 5/8) mottles; single grained; loose; few fine distinct dark brown (10YR 2/2) stains; few fine yellowish red (5YR 4/6) broken bandlike streaks; common fine roots; slightly acid; gradual wavy boundary.

B31t—32 to 44 inches; light brownish gray (10YR 6/2) fine sand; common medium distinct yellowish red (5YR 5/8) mottles; single grained; very friable; discontinuous 1/8- to 1/4-inch thick bands of strong brown (7.5YR 5/6) loamy fine sand and loamy sand; few fine roots; common fine distinct reddish brown (5YR 4/4) concretions of iron and manganese oxides in the lower 2 inches; neutral; abrupt wavy boundary.

B32t—44 to 51 inches; pale brown (10YR 6/3) fine sand; common medium distinct strong brown (7.5YR 5/6) and grayish brown (2.5YR 5/2) mottles; single grained; very friable; thin discontinuous strong brown (7.5YR 5/6) bands of loamy sand; common fine distinct reddish brown (5YR 4/4) concretions of iron and manganese oxides; few fine roots; neutral; abrupt wavy boundary.

C—51 to 74 inches; light brownish gray (10YR 6/2) fine sand; common medium distinct grayish brown (2.5YR 5/2) and strong brown (7.5YR 5/6) mottles; single grained; loose; neutral.

The solum is 42 to 90 inches thick. The depth to carbonates is 48 to 90 inches. In some pedons, the C horizon is neutral or mildly alkaline.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 to 3. It is fine sand or sand and is medium acid to neutral. Pedons in wooded areas have an A1 horizon 2 to 5 inches thick that has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B2 horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 4 to 6. It is fine sand, sand, or loamy fine sand and is medium acid to neutral.

The B3 horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. The lamellae in the Bt horizons have hue of 10YR to 5YR, value of 3 to 5, and chroma of 4 to 8. They are loamy fine sand, loamy sand, or fine sandy loam. The B3 horizon is slightly acid or neutral.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 3. It is fine sand, sand, or loamy fine sand and is neutral to moderately alkaline.

Rimer series

The Rimer series consists of deep, somewhat poorly drained soils on outwash plains, beach ridges, and deltas. Rimer soils formed in sandy and loamy material 20 to 32 inches thick over fine or moderately fine textured material. Permeability is rapid in the sandy material and very slow in the underlying material. The slope is 0 to 3 percent.

Rimer soils commonly are adjacent to Seward and Wauseon soils. They are similar to Bixler, Dixboro, and Tedrow soils. Unlike Rimer soils, Seward soils do not have colors of low chroma in the upper part of the argillic horizon. Wauseon soils have a mollic epipedon and are grayer in the subsoil than Rimer soils. Bixler soils have less clay in the argillic horizon and are underlain by stratified silt loam and very fine sand. Dixboro soils have more clay and silt in the upper part of the solum than Rimer soils and are underlain by stratified silt loam and very fine sand. Unlike Rimer soils, Tedrow soils are sandy throughout.

Typical pedon of Rimer loamy fine sand, 0 to 3 percent slopes, about 1/2 mile southeast of a large quarry in Waterville Township, 2,300 feet north and 900 feet west of the southeast corner of sec. 2, T. 6 N., R. 9 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loamy fine sand; granular; friable; common fine roots; few fine distinct dark reddish brown (5YR 4/2) stains; strongly acid; abrupt smooth boundary.

A21—10 to 16 inches; brown (10YR 5/3) loamy fine sand; common medium distinct dark yellowish brown (10YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium platy structure; friable; common medium distinct reddish brown (10YR 4/4) stains; medium acid; clear wavy boundary.

A22—16 to 24 inches; grayish brown (10YR 5/2) loamy fine sand; common medium distinct dark yellowish brown (10YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; single grained; friable; few fine roots; common fine distinct black (10YR 2/1) concretions of iron and manganese oxides; medium acid; abrupt wavy boundary.

B21t—24 to 31 inches; dark brown (10YR 4/3) fine sandy loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy gray (10YR 5/1) clay films on vertical and horizontal faces of peds; common medium distinct black (10YR 2/1) concretions of iron and manganese oxides; slightly acid; few fine roots; abrupt wavy boundary.

IIB22tg—31 to 38 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure; very firm; common fine distinct black (10YR 2/1) concretions of iron and manganese oxides; thin patchy clay films on vertical and horizontal faces of peds; neutral; abrupt smooth boundary.

IICg—38 to 64 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and few fine distinct greenish gray (5GY 6/1) mottles; moderate medium platy structure due to stratification; very firm; few thin seams of sand; strong effervescence; moderately alkaline.

The solum is 26 to 44 inches thick. The sandy and loamy material is 20 to 32 inches thick. The content of gravel in the sandy material is 0 to 3 percent.

The A horizon has hue of 10YR, value of 4, and chroma of 1 to 3. It is strongly acid to neutral.

The A2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is loamy fine sand or fine sand and is strongly acid to neutral.

The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is fine sandy loam or sandy loam. In some pedons there are thin subhorizons of light sandy clay loam. Gravel makes up 0 to 8 percent of this horizon. The B2t horizon is strongly acid to neutral.

The IIB horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is heavy clay loam or silty clay and is slightly acid to mildly alkaline. Coarse fragments make up 0 to 8 percent of this horizon. The IIC horizon has the same range in color and texture as the IIB horizon.

Ross series

The Ross series consists of deep, well drained soils that formed in alluvium deposited by streams on flood plains. Permeability is moderate. The slope is 0 to 2 percent.

Ross soils are similar to Eel soils. Unlike Ross soils, Eel soils do not have dark surface and subsurface layers.

Typical pedon of Ross loam, occasionally flooded, in Side Cut Metropark in Maumee, Monclova Township, 100 feet south and 550 feet west of bridge over Silver Lake outlet on South River Road:

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam; moderate fine and medium granular structure; friable; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 17 inches; very dark gray (10YR 3/1) fine sandy loam; moderate medium subangular blocky structure; friable; common fine roots; few pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

A13—17 to 25 inches; very dark gray (10YR 3/1) fine sandy loam; moderate medium angular blocky structure; friable; few fine roots; slight effervescence; mildly alkaline; clear wavy boundary.

B21—25 to 35 inches; dark brown (10YR 4/3) loam; common very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate medium angular blocky structure; friable; few fine roots; slight effervescence; mildly alkaline; gradual wavy boundary.

B22—35 to 40 inches; dark brown (10YR 4/3) loam; weak medium angular blocky structure; friable; few fine roots; 2 percent shells and shell fragments; slight effervescence; moderately alkaline; clear wavy boundary.

C—40 to 60 inches; dark brown (10YR 4/3) sandy loam; massive; friable; few very dark grayish brown (10YR 3/2) coatings in cracks; strong effervescence; moderately alkaline.

The solum is 25 to 40 inches thick. The average clay content in the control section ranges from 18 to 25 percent. The mollic epipedon is 24 to 40 inches thick. In some pedons, it extends into the B horizon. The soil is slightly acid to moderately alkaline throughout. In some pedons, it is calcareous.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The Ap horizon is loam. In the lower part, the A horizon ranges to fine sandy loam.

The B horizon has hue of 10YR, value of 4, and chroma of 3 or 4. It is dominantly loam. In some pedons, there are strata of silt loam.

The C horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 2 to 4. It ranges from sandy loam to clay loam and has strata of sandy and gravelly material.

Seward series

The Seward series consists of deep, moderately well drained soils on outwash plains, beach ridges, and deltas. Seward soils formed in sandy material 20 to 32 inches thick over moderately fine and fine textured material. Permeability is rapid in the sandy material and slow or very slow in the underlying material. The slope ranges from 2 to 6 percent.

Seward soils commonly are adjacent to Dunbridge, Rimer, and Wauseon soils. They are similar to Ottokee soils. Unlike Seward soils, Dunbridge soils have a lithic contact within a depth of 20 to 40 inches. Rimer soils have colors of low chroma in the upper part of the argillic horizon. Wauseon soils have a mollic epipedon, and they are more poorly drained than Seward soils. Ottokee soils are sandy throughout and do not have moderately fine or fine textured material in the lower part of the subsoil and in the substratum.

Typical pedon of Seward loamy fine sand, 2 to 6 percent slopes, in Waterville Township, 1,408 feet north and 2,200 feet west of the southeast corner of sec. 2, T. 6 N., R. 9 E.

Ap1—0 to 8 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak medium granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

Ap2—8 to 15 inches; brown (10YR 4/3) loamy fine sand; weak medium granular structure; friable; few fine distinct very dark gray (10YR 3/1) stains; common fine roots; medium acid; abrupt smooth boundary.

A21—15 to 21 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; few fine distinct very dark gray (10YR 3/1) organic stains; few fine roots; slightly acid; gradual wavy boundary.

A22—21 to 32 inches; yellowish brown (10YR 5/4) fine sand; common medium distinct pale brown (10YR 6/3) and strong brown (7.5YR 5/8) mottles; single grained; loose; few fine roots; slightly acid; clear smooth boundary.

B21t—32 to 34 inches; dark yellowish brown (10YR 4/4) fine sandy loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; thin patchy brown (10YR 4/3) clay films on faces of peds and bridging sand grains; neutral; abrupt smooth boundary.

IIB22t—34 to 38 inches; brown (10YR 5/3) clay loam; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; 3 percent pebbles; thin patchy brown (10YR 4/3) clay films on vertical faces of peds; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIC—38 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct dark gray (10YR 4/1) mottles; massive; very firm; 3 percent pebbles; strong effervescence; moderately alkaline.

The solum is 24 to 44 inches thick. The depth to carbonates is 20 to 44 inches. The more sandy part of the solum is 20 to 32 inches thick. Gravel makes up 0 to 3 percent of the sandy material and 0 to 8 percent of the finer textured underlying material.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid or slightly acid. The A2 horizon has hue of 10YR and value and chroma of 4 to 6. It is loamy fine sand or fine sand and is slightly acid or medium acid.

The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, fine sandy loam, or light sandy clay loam and is slightly acid or neutral.

The IIBt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam, clay, or silty clay.

The IIC horizon has hue of 10YR, value of 3 or 4, and chroma of 3 or 4. It is clay loam, clay, or silty clay.

Shoals series

The Shoals series consists of deep, somewhat poorly drained soils that formed in loamy alluvium on flood plains. Permeability is moderate. The slope is 0 to 2 percent.

Shoals soils commonly are adjacent to Eel and Sloan soils and are similar to Ceresco soils. Unlike Shoals soils, Eel soils do not have dominantly low-chroma colors in the control section. Sloan soils are dominantly gray immediately below the mollic epipedon. Ceresco soils have a mollic epipedon and have more sand in the control section than Shoals soils.

Typical pedon of Shoals loam, occasionally flooded, about 3 3/4 miles northeast of Grand Rapids in Providence Township, 200 feet south and 2,000 feet east of the intersection of U.S. 24 and Heller Road:

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

B21—9 to 13 inches; dark brown (10YR 4/3) loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; common fine roots; neutral; clear wavy boundary.

B22—13 to 26 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct dark brown (10YR 4/3) and yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

B23—26 to 34 inches; grayish brown (10YR 5/2) loam; common medium distinct dark brown (10YR 4/3) and yellowish brown (10YR 5/4) mottles; moderate medium granular structure; friable; mildly alkaline; clear smooth boundary.

C—34 to 60 inches; dark brown (10YR 4/3) stratified loam, silt loam, and clay loam; thin strata of sand; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4, 5/6) mottles; massive; friable; few shells; slight effervescence; moderately alkaline.

The solum is 24 to 42 inches thick. The depth to free carbonates is 20 to 52 inches. Gravel makes up 0 to 5 percent of the solum and 0 to 10 percent of the substratum, depending on stratification. The soil in the control section is 18 to 27 percent clay.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is slightly acid to mildly alkaline. Pedons in wooded areas have an A1 horizon 2 to 5 inches thick that has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam, silt loam, clay loam, and silty clay loam and has thin subhorizons of sandy clay loam or sandy loam. The B horizon is slightly acid to mildly alkaline.

The C horizon has hue of 10YR to 2.5Y, value of 4 to 6, and chroma of 1 to 3. It varies in texture because of the stratification. It is mildly alkaline or moderately alkaline.

Sisson series

The Sisson series consists of deep, well drained soils that are mainly on deltas in areas of former lake plains. Sisson soils formed in stratified loamy and silty material; each stratum is relatively thick and uniform in texture.

Permeability is moderate. The slope ranges from 2 to 18 percent.

Sisson soils commonly are adjacent to Colwood and Dixboro soils. Unlike Sisson soils, Colwood soils have a mollic epipedon, and they are grayer in the subsoil. Dixboro soils have a thicker dark surface layer and are grayer in the subsoil.

Typical pedon of Sisson loam, 12 to 18 percent slopes, about 3 miles west of the Toledo city limits in Springfield Township, 910 feet south and 1,310 feet west of the northeast corner of sec. 29:

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) loam; moderate fine granular structure; friable; common fine roots, few medium roots; slightly acid; clear wavy boundary.

A2—3 to 9 inches; brown (10YR 5/3) loam; weak medium platy structure parting to moderate fine subangular blocky; friable; common fine roots; common medium distinct very dark grayish brown (10YR 3/2) stains; slightly acid; clear wavy boundary.

B21t—9 to 21 inches; yellowish brown (10YR 5/4) silt 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 roots; neutral; gradual wavy boundary.

B22t—21 to 33 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; thin continuous brown (7.5YR 5/4) clay films on faces of peds; neutral; clear wavy boundary.

B3t—33 to 40 inches; brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; thin patchy brown (7.5YR 4/4) clay films on vertical faces of peds; slight effervescence; mildly alkaline; abrupt wavy boundary.

C—40 to 60 inches; dark yellowish brown (10YR 4/4) and brown (10YR 5/3) stratified silty clay loam, silt loam, and very fine sand; massive and stratified; friable; strong effervescence; moderately alkaline.

The solum is 26 to 42 inches thick. The content of coarse fragments is less than 1 percent.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is slightly acid to neutral. Pedons in wooded areas have an A1 horizon 1 to 3 inches thick that has hue of 10YR, value of 3, and chroma of 1 or 2. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is loam, silt loam, silty clay loam, or clay loam. In some pedons there are thin subhorizons of fine sandy loam. The B horizon is slightly acid or neutral in the upper part and neutral to moderately alkaline in the lower part.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is silt loam, very fine sandy loam, and very fine sand and has thin strata of silty clay and silty clay loam.

Sloan series

The Sloan series consists of deep, very poorly drained soils that formed in loamy alluvium on flood plains. Permeability is moderate or moderately slow. The slope is 0 to 2 percent.

Sloan soils commonly are adjacent to Ceresco, Eel, and Shoals soils. Eel soils have better drainage and have brighter colors in the control section than Sloan soils. Unlike Sloan soils, Shoals soils do not have a mollic epipedon and do not have dominant low-chroma colors immediately below the surface horizon. Ceresco soils have more sand and have brighter colors in the control section than Sloan soils.

Typical pedon of Sloan loam, occasionally flooded, about 1/2 mile northeast of Monclova in Monclova Township, 840 feet north and 1,230 feet east of the center of sec. 5, T. 1.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A12—9 to 12 inches; very dark grayish brown (10YR 3/2) loam; moderate medium granular structure; friable; common fine roots; neutral; abrupt wavy boundary.

B21g—12 to 20 inches; dark grayish brown (10YR 4/2) loam; weak medium subangular blocky structure; friable; common fine roots; common fine and medium reddish brown (5YR 4/4) stains; neutral; abrupt smooth boundary.

B22g—20 to 28 inches; grayish brown (10YR 5/2) clay loam; common medium distinct dark brown (10YR 4/3) mottles; weak medium subangular blocky structure; firm; few fine roots; common medium very dark grayish brown (10YR 3/2) organic stains and reddish brown (5YR 4/4) stains; neutral; gradual wavy boundary.

B23g—28 to 36 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; neutral; gradual wavy boundary.

C1—36 to 58 inches; dark grayish brown (10YR 4/2) loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; massive; firm; 1 percent gravel; neutral; gradual wavy boundary.

C2—58 to 67 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct dark brown

(7.5YR 4/4) mottles; massive; firm; mildly alkaline; slight effervescence.

The depth to carbonates and the thickness of the solum commonly range from 30 to 50 inches. The average clay content in the control section ranges from 18 to 35 percent. The soil is slightly acid to mildly alkaline in the A horizon and neutral to mildly alkaline in the B horizon. The mollic epipedon generally is 11 to 16 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, clay loam, or silt loam. In some pedons, subhorizons of loam, sandy loam, and loamy sand are in the B horizon.

The C horizon consists of strata of silty clay loam, clay loam, silt loam, and loam; these strata are coarser textured as depth increases. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is 0 to 20 percent gravel.

Spinks series

The Spinks series consists of deep, well drained soils that formed in sandy material on postglacial beach ridges and dunes. Permeability is moderately rapid or rapid. The slope ranges from 2 to 6 percent.

Spinks soils commonly are adjacent to Dunbridge, Granby, Oakville, Ottokee, and Tedrow soils. Unlike Spinks soils, Dunbridge soils have a lithic contact within a depth of 20 to 40 inches, and they have more clay. Granby soils have a mollic epipedon and are grayer in the subsoil than Spinks soils. Oakville soils do not have an argillic horizon. Ottokee soils do not have an argillic horizon; they have colors that have chroma of 2 within a depth of 40 inches. Unlike Spinks soils, Tedrow soils have mottles of low chroma in the upper part of the subsoil.

Typical pedon of Spinks fine sand, 2 to 6 percent slopes, about 1 mile north of airport in Spencer Township, 2,400 feet north and 2,400 feet west of the southeast corner of sec. 35, T. 8 N., R. 9 E.

O1—1 inch to 0; leaf litter, organic mull.

A1—0 to 2 inches; very dark brown (10YR 2/2) fine sand; weak medium granular structure; very friable; many fine and common medium roots; medium acid; abrupt smooth boundary.

A21—2 to 6 inches; dark brown (7.5YR 4/4) loamy fine sand; single grained; loose; many fine and few medium roots; medium acid; abrupt smooth boundary.

A22—6 to 22 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; common fine and few medium roots; medium acid; abrupt wavy boundary.

A&B—22 to 84 inches; yellowish brown (10YR 5/6), light brown (10YR 6/4), and pale brown (10YR 6/3) fine sand (A2); single grained; loose; lamellae, 1/8 inch to 2 inches thick, of strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) loamy fine sand (Bt); weak fine subangular blocky structure; very friable; few fine roots; slightly acid, becoming neutral as depth increases; gradual wavy boundary.

The solum is 42 to 96 inches thick. The depth to carbonates is 42 to 140 inches or more. Gravel makes up 0 to 5 percent of the soil and generally occurs as stone lines.

The Ap horizon, where present, has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is medium acid to neutral. Pedons in wooded areas have an A1 horizon 1 to 4 inches thick that has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The A2 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. It is loamy fine sand, fine sand, or sand and is medium acid to neutral.

The A part of the A&B horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is fine sand, sand, or loamy sand. The B part of the A&B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. The individual lamellae are loamy sand, loamy fine sand, or light sandy loam. They are 1/8 inch to 4 inches thick. The A&B horizon ranges from medium acid to mildly alkaline.

The C horizon, where present, has hue of 10YR, value of 5 to 7, and chroma of 3 or 4. It is fine sand, sand, or loamy fine sand and is neutral to moderately alkaline.

St. Clair series

The St. Clair series consists of deep, moderately well drained soils on till plains in areas of former lake beds. St. Clair soils formed in calcareous glacial till that was modified in the upper part by the action of water in an old glacial lake. Permeability is slow or very slow. The slope ranges from 2 to 25 percent.

St. Clair soils commonly are adjacent to Hoytville and Nappanee soils. Hoytville soils have a grayer subsoil than St. Clair soils, and they have a dark surface layer. Nappanee soils have colors that have chroma of 2 immediately below the Ap horizon.

Typical pedon of St. Clair silty clay loam, 12 to 25 percent slopes, severely eroded, in Monclova Township, 1,200 feet south of the center of the cloverleaf intersection of I-475 and U.S. 24:

Ap—0 to 2 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

B21t—2 to 8 inches; dark yellowish brown (10YR 4/4) clay; moderate fine angular blocky structure; very firm; common fine roots; dark brown (10YR 4/3) faces of peds; pale brown (10YR 6/3) silt coatings; thin patchy clay films; 2 percent gravel; slightly acid; gradual wavy boundary.

B22t—8 to 21 inches; dark yellowish brown (10YR 4/4) clay; weak medium prismatic structure parting to moderate fine angular blocky; very firm; few fine roots; thin patchy dark brown (10YR 4/3) clay films; 2 percent gravel; slightly acid; abrupt wavy boundary.

C1—21 to 30 inches; dark yellowish brown (10YR 4/4) clay; few fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very firm; dark brown (10YR 4/3) faces of peds; thin patchy dark grayish brown (10YR 4/2) clay films; 5 percent gravel; slight effervescence; moderately alkaline; abrupt wavy boundary.

C2—30 to 60 inches; dark yellowish brown (10YR 4/4) clay; common medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) mottles; massive; very firm; white (10YR 8/2) segregations of secondary carbonates; 5 percent gravel; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 30 inches. The average clay content in the control section ranges from 50 to 60 percent. The soil is medium acid to neutral in the upper part of the solum and medium acid to moderately alkaline in the lower part of the B horizon. The solum is 0 to 8 percent coarse fragments.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay or silty clay.

The C horizon has the same range in color as the B horizon. It is clay or clay loam.

Tedrow series

The Tedrow series consists of deep, somewhat poorly drained soils that formed in sandy material on glacial beach ridges and dunes. Permeability is rapid. The slope is 0 to 3 percent.

Tedrow soils commonly are adjacent to Gilford, Granby, Oakville, Ottokee, and Spinks soils. They are similar to Bixler, Dixboro, and Rimer soils. Gilford and Granby soils have a mollic epipedon and are grayer than Tedrow soils. Gilford soils have more clay. Unlike Tedrow soils, Oakville and Spinks soils do not have mottles or matrix colors that have chroma of 2 or less within a depth of 40 inches. Spinks soils have an argillic horizon. Ottokee soils have mottles of low chroma in the lower part of the B horizon, and they are brighter than Tedrow soils. Bixler soils have loamy material within a depth of 40 inches. Dixboro soils have more silt and clay than Tedrow soils.

Typical pedon of Tedrow fine sand, 0 to 3 percent slopes, about 1 mile southeast of Swanton in Swanton Township, 750 feet south and 2,200 feet west of the northeast corner of sec. 18, T. 7 N., R. 9 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sand, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; few fine distinct black (10YR 2/1) concretions of iron and manganese oxides; many fine roots; slightly acid; abrupt smooth boundary.

B1—9 to 18 inches; yellowish brown (10YR 5/6) fine sand; very weak medium granular structure; very friable; common fine distinct very dark grayish brown (10YR 3/2) root channels and common medium distinct yellowish red (5YR 4/6) stains; common fine roots; slightly acid; abrupt wavy boundary.

B21—18 to 24 inches; pale brown (10YR 6/3) fine sand; few fine faint light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; single grained; loose; common medium distinct reddish brown (5YR 4/4) and black (10YR 2/1) concretions of iron and manganese oxides; few fine distinct very dark gray (10YR 3/1) root channels; few fine roots; neutral; abrupt wavy boundary.

B22—24 to 35 inches; pale brown (10YR 6/3) fine sand; common medium distinct light brownish gray (2.5YR 6/2) and yellowish brown (10YR 5/6) mottles; single grained; loose; common medium distinct strong brown (7.5YR 5/6) stains; neutral; abrupt wavy boundary.

B3—35 to 41 inches; yellowish brown (10YR 5/6) fine sand; many medium distinct light brownish gray (10YR 6/2) mottles; single grained; loose; few fine distinct black (10YR 2/1) stains; neutral; abrupt wavy boundary.

C1—41 to 52 inches; light brownish gray (10YR 6/2) fine sand; common medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; single grained; loose; few fine distinct black (10YR 2/1) stains; neutral; abrupt smooth boundary.

C2—52 to 64 inches; grayish brown (10YR 5/2) fine sand; common large distinct light olive brown (2.5YR 5/6) mottles; single grained; loose; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 26 to 54 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is slightly acid or neutral. Pedons in wooded areas have an A1 horizon 1 to 4 inches thick that has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. It is fine sand, sand, loamy sand, or loamy fine sand and is slightly acid or neutral.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is fine sand or sand. In some pedons, it has thin strata of silt and silty clay. The C horizon is neutral to moderately alkaline.

Toledo series

The Toledo series consists of deep, very poorly drained soils that formed in clayey lake-laid sediment on lake plains and deltas. Permeability is slow. The slope is 0 to 2 percent.

Toledo soils commonly are adjacent to Fulton soils and are similar to Hoytville, Latty, and Lenawee soils. Fulton soils have brighter colors in the subsoil than Toledo soils. Hoytville soils formed in till and have some gravel. Latty soils have an ochric surface. Lenawee soils have less clay in the subsoil than Toledo soils and are underlain by stratified silt loam and silty clay loam.

Typical pedon of Toledo silty clay, about 1 1/2 miles northeast of Clay High School in Oregon Township, 1,000 feet north and 1,000 feet west of the southeast corner of sec. 30, T. 9 S., R. 9 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay; moderate medium subangular blocky structure; firm; few fine and medium roots; slightly acid; abrupt smooth boundary.

B21g—9 to 20 inches; dark gray (10YR 4/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very firm; few fine roots; few black (10YR 2/1) krotovinas; neutral; clear smooth boundary.

B22g—20 to 30 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very firm; few fine distinct dark brown (7.5YR 4/4) stains; few fine roots; neutral; gradual smooth boundary.

B23g—30 to 47 inches; gray (10YR 5/1) silty clay; few fine distinct brown (7.5YR 5/4) mottles; weak medium angular blocky structure; very firm; neutral; clear smooth boundary.

Cg—47 to 60 inches; gray (10YR 5/1) silty clay; common medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; few fine distinct yellowish brown (10YR 5/4) mottles; massive and laminated; very firm; strong effervescence; moderately alkaline.

The solum is 35 to 55 inches thick. The depth to carbonates is 35 to 50 inches. The average clay content in the control section ranges from 45 to 56 percent. The A and B horizons are slightly acid or neutral.

The A horizon has hue of 10YR or 2.5Y, value of 3, and chroma of 1 or 2.

The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay that is less than 12 percent sand.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is silty clay. In some pedons, it has a few thin layers of silt to fine sand.

Wauseon series

The Wauseon series consists of deep, very poorly drained soils on outwash plains, beach ridges, and deltas. The Wauseon soils formed in loamy material 20 to 36 inches thick over clayey material. Permeability is rapid in the loamy material and very slow in the clayey material. The slope is 0 to 2 percent.

Wauseon soils commonly are adjacent to Rimer and Seward soils and are similar to Gilford, Lamson, and Mermill soils. Unlike Wauseon soils, Rimer and Seward soils do not have a mollic epipedon and colors of low chroma in the upper part of the solum. Gilford soils are underlain by moderately coarse textured material. Lamson soils do not have a mollic epipedon and are underlain by stratified silt loam to fine sand. Mermill soils have more clay in the subsoil than Wauseon soils and do not have a mollic epipedon.

Typical pedon of Wauseon fine sandy loam, about 2 miles southeast of Richfield Center in Richfield Township, 2,800 feet south and 1,800 feet east of the northwest corner of sec. 26, T. 9 S., R. 5 E.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam; weak medium granular structure; very friable; many fine roots; neutral; clear smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) fine sandy loam; few fine distinct dark gray (10YR 4/1) and yellowish brown (10YR 5/6) mottles; weak thin platy structure; friable; many fine roots; neutral; clear smooth boundary.

B21g—12 to 20 inches; gray (10YR 5/1) fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; common medium distinct very dark gray (10YR 3/1) stains; mildly alkaline; clear wavy boundary.

B22g—20 to 30 inches; grayish brown (10YR 5/2) fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; few fine roots; few reddish brown (5YR 4/4) pipestem-shaped iron and manganese concretions; mildly alkaline; abrupt wavy boundary.

IIC1g—30 to 41 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) and many medium distinct reddish brown (10YR 5/4) mottles; massive; firm; few fine roots; few fine distinct dark gray silt coatings; 1 percent coarse fragments; strong effervescence; moderately alkaline; abrupt wavy boundary.

IIC2g—41 to 60 inches; gray (10YR 5/1) silty clay; massive; firm; 2 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to the underlying material range from 24 to 36 inches. The soil is neutral to slightly acid in the surface horizon and neutral to mildly alkaline in the Bg horizon. The mollic epipedon is 10 to 14 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is fine sandy loam or sandy loam and has thin subhorizons of loamy fine sand and very fine sand.

The IIC horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 4. It is clay, silty clay, or silty clay loam.

Formation of the soils

The characteristics of a soil are determined by the interaction of five factors of soil formation—climate, plants and animals, parent material, relief, and time (*3*). The relative effect of each factor varies from place to place.

Climate and vegetation act on the parent material and gradually change it to a natural body of soil. The nature of the parent material affects the kind of soil that is formed. Relief modifies the effects of climate and vegetation, mainly through its influence on runoff and temperature. And time is needed for a soil to form from parent material; generally, a long period of time is required for distinct soil horizons to develop.

The interaction among these factors is more complex for some soils than for others. On the following pages, the five main factors of soil formation are described as they relate to the soils in the survey area.

Factors of soil formation

Climate

Climate is largely responsible for determining the kind of vegetation in an area. The climate in Lucas County has been relatively uniform for a long period of time, and hardwood trees are the climax vegetation.

The climate also has affected soil reaction. Percolating water has leached bases and carbonates from most of the soils so that many soils are acid to a moderate depth. In most soils, differences in soil reaction in the upper 2 feet can be partly attributed to differences in the carbonate content of the parent material.

The frequency of rainfall has resulted in wetting and drying cycles that have increased the downward movement of clay minerals. For example, the Del Rey, Fulton, and Digby soils have horizons of clay accumulation in their subsoil. Freezing and thawing have aided in the development of soil structure in many of the clayey soils. Warm temperatures in summer have increased biological and chemical activity in the soils.

The climate is relatively uniform throughout the county. However, the area near Lake Erie is slightly warmer and has a longer frost-free period than other areas in the county. Also, differences in relief have resulted in differences in the microclimate in some areas.

All the soils in Lucas County are classified as mesic because of their soil temperature. The average annual soil temperature at a depth of 20 inches is about 2 degrees F higher than the average annual air temperature. It ranges from 47 degrees F (8 degrees C) to 59 degrees F (15 degrees C).

Plants and animals

The hardwood trees in Lucas County have greatly affected soil formation. Soils in the Oak Openings formed under forest vegetation comprising several species of oak and other hardwood trees. Soils in the Great Black Swamp and other low-lying areas formed under swamp forest vegetation comprising mainly elm and ash. The leaves of these native trees had a relatively low content of bases. In undisturbed areas, most of the soils in the county have a thin surface layer of organic matter accumulation and upper horizons that are relatively low in accumulated bases. Thick organic deposits, the parent material of Muskego soils, accumulated in depressions where the water table was high for a long period of time. The organic material in these deposits consists mainly of the remains of trees, grasses, and sedges.

Fungi, bacteria, and animals, including earthworms, rodents, and insects, also have added some organic matter to the soils and have mixed the soil material to some extent. Tree windthrow, particularly in areas of the poorly drained soils, also has caused mixing of soil material. In wooded areas of poorly drained soils, a pronounced microrelief of low knolls and depressions has resulted from this windthrow.

In most areas, the soils have been cleared of trees and used as cropland. Many areas in the Oak Openings have been reforested. Man has changed the soils by accelerating the rate of erosion in some areas and by cutting and filling during construction. In addition, extensive drainage projects have lowered the water table in many areas; additions of lime and fertilizer have changed soil chemistry; and tillage has affected the structure of the surface layer.

Parent material

The main kinds of parent material in Lucas County are glacial till, lacustrine sediment, glacial-lake beach ridge deposits, deltaic sediment deposited in postglacial lakes, and recent alluvium (fig. 9). Parent material has greatly affected the texture of the soils.

Hoytville, Nappanee, and St. Clair soils formed in clay loam glacial till. Ottokee and Tedrow soils formed in sandy beach deposits. Colwood, Dixboro, and Sisson soils formed in deltaic sediment of silty or loamy material. Latty, Fulton, and Toledo soils formed in clayey lacustrine deposits. The rest of the soils in the county formed

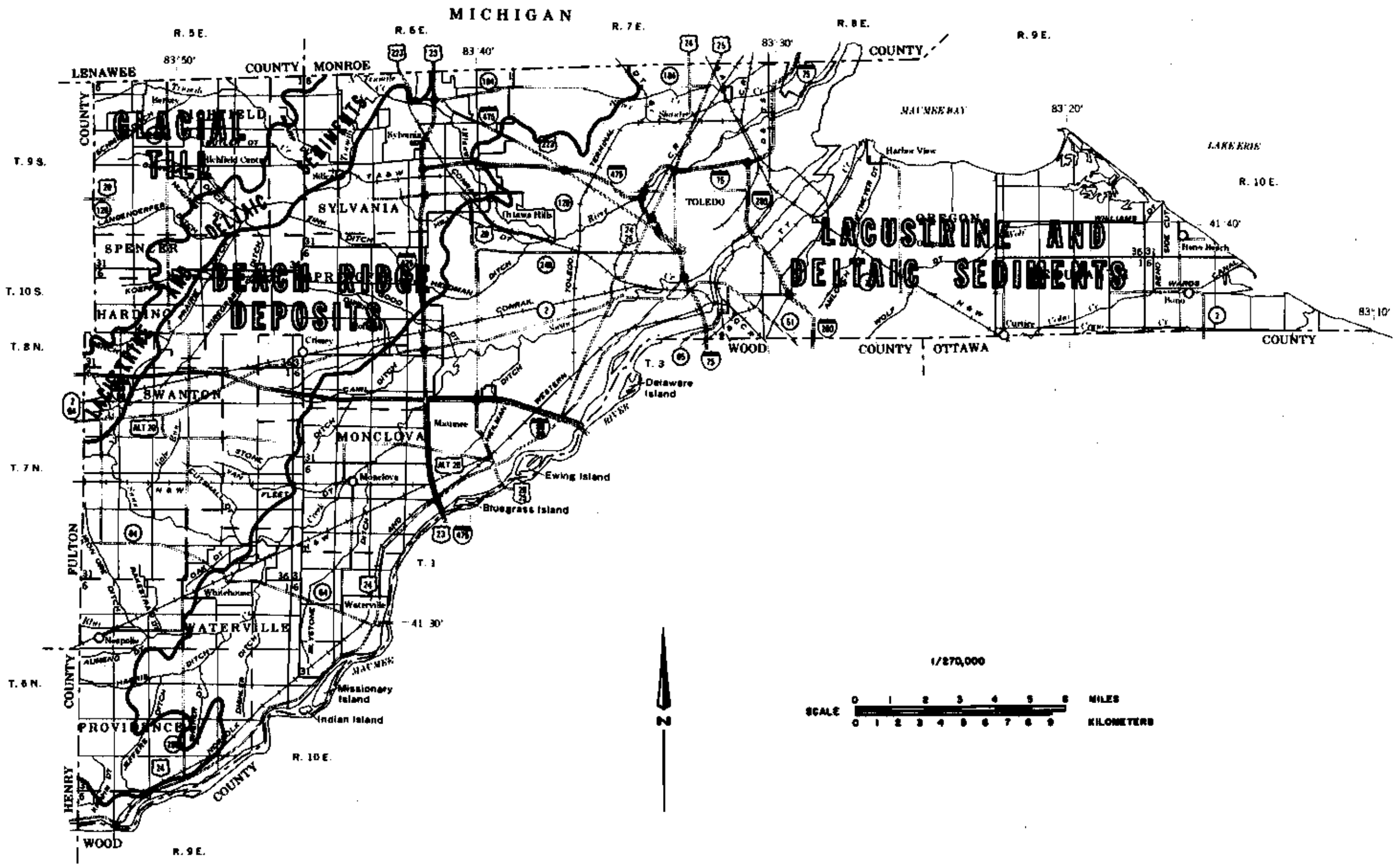


Figure 9.—Location and extent of the different kinds of parent material in Lucas County, Ohio.

in mixed parent materials, and many of their characteristics were determined by the proportion and sequence of the layers of these different materials.

The parent material of most of the soils in the county were relatively high in calcium and magnesium carbonates. Weathering of the parent material has reduced the amount of carbonates that remain in the surface layer and upper part of the subsoil of these soils.

Relief

Relief tends to modify the effects of climate within short horizontal distances. Soils on hillsides, for example, generally are drier than those in adjacent depressions because water runs off the hillsides and collects in the depressions. The presence or absence of a seasonal high water table is largely determined by relief. Nearly all of the nearly level soils, including Del Rey, Granby, and Latty soils, have a seasonal high water table.

Because of rapid runoff and erosion, the sloping or steep soils in a series generally are less thick than the nearly level soils in the same series. The lower rates of percolation and leaching in these soils results in less weathering of the parent material.

Differences in drainage among soils that formed in similar parent materials are largely caused by differences in relief. The Oakville, Ottokee, Tedrow, and Granby soils are in a drainage sequence that can illustrate the effect of relief on drainage. Oakville soils are well drained; they generally are in higher positions on the landscape than the other soils in this sequence. Ottokee soils are moderately well drained; they generally are in lower positions than the Oakville soils. Tedrow soils are somewhat poorly drained; they generally have less relief than the Oakville and Ottokee soils. Granby soils are very poorly drained; they are in the lowest landscape positions.

In Lucas County, the steepest slopes are in areas of the sandy beach ridges and along major drainageways. The rest of the county is level to nearly level. Most of the more poorly drained soils are in the level and nearly level areas.

Time

Time is required for the development of distinct horizons in a soil. The length of time that parent material has been in place and affected by vegetation and climate is an important factor in soil formation. The influence of time on soil formation is modified by relief and the nature of the parent material.

Time has caused few differences among the soils in Lucas County because most of the parent materials have been in place for about the same amount of time. Soils that formed in recent alluvium, for example, the Ceresco, Shoals, and Sloan soils, are exceptions. These soils are on flood plains and are periodically flooded. The sediment deposited with each flood prevents the development of distinct horizons.

In terms of geologic age, the soils in Lucas County have been developing for a relatively short period of time. This accounts for the shallowness of leaching and the slightly acid to neutral reaction in many of the soils.

Processes of soil formation

The factors of soil formation discussed in the preceding section govern the four soil-forming processes—additions, losses, transfers, and alterations (*5*). Some of these processes cause differences within a soil, while others retard or preclude differences. The differentiation of horizons in soils is a result of one or more of these processes.

Additions

One of the main kinds of addition is the accumulation of organic matter in the surface layer of soils. Others include the addition of bases derived from organic matter, ground water, or lime and fertilizer and deposition resulting from erosion. The dark surface layer of Hoytville, Toledo, Gilford, Lamson, and Colwood soils illustrates the addition of organic matter. All the soils in Lucas County have some organic matter accumulation; however, where the layer of accumulation was originally thin, plowing and cultivating has largely destroyed it or incorporated it into other layers. The Nappanee, St. Clair, Fulton, and Ottokee soils are examples of soils that have a limited addition of organic matter.

In all soils, plant nutrients are recycled from the soil to plants and back to the soil in the form of plant litter or organic material. Lime and fertilizer can be applied on cropland and pasture to counteract the loss of plant nutrients that is common to most soils. If these applications are heavy, nutrient gains can exceed nutrient losses.

Soils that are seasonally saturated, for example, the Mermill and Colwood soils, continually accumulate bases derived from the ground water. Generally, the addition of bases in these soils is greater than the loss of bases.

Soils on flood plains, for example, Eel and Shoals soils, periodically receive additions of soil material deposited by floodwaters.

Losses

Losses that occur in soils include the leaching of bases, the removal of plant nutrients by crops, the loss of soil through erosion, and volatilization. One of the main losses in the soils in Lucas County is the leaching of carbonates. In most of the fine-textured, light-colored soils on uplands, carbonates have been leached to a depth of 20 to 35 inches. Prior to weathering, the glacial till or lacustrine clay in which these soils formed was 15 to 25 percent calcium carbonate. Carbonates in the coarser textured soils, including Oakville, Ottokee, and Spinks soils, generally have been leached to a greater depth—from 3 to 10 feet.

The loss of carbonates precedes other chemical changes in the solum, and it occurs more slowly in soils that have a high content of carbonates. Other minerals also are subject to chemical weathering and loss through leaching but at a slower rate.

Transfers

The main kind of transfer in the soils in Lucas County is the transference of colloidal material from the surface layer to a layer at a greater depth. The primary minerals are transformed into silicate clay minerals, largely through the processes of hydrolysis and base substitution. The clay is carried downward by percolating water and is deposited as clay films on the faces of soil peds, in cracks, and in root and earthworm channels. Most of the clay remains in the soil profile. Del Rey, Haskins, Nappanee, and Fulton soils, for example, have clay films.

The translocation and development in place of silicate clay minerals has greatly influenced horizon development in many of the soils in Lucas County. Various sesquioxides also have been transferred from the surface layer to lower layers through this weathering process.

Alterations

The reduction and solution of ferrous iron has taken place in the very poorly drained and somewhat poorly drained soils. This reduction of iron, called gleying, is evident in Hoytville, Toledo, Granby, Colwood, and Latty soils and is caused by a recurring high water table. Gray soil material indicates that conditions favorable to the reduction process are present. Reduced iron is soluble, but in the soils in Lucas County it commonly has been moved only a short distance within the soil.

Some of this iron is reoxidized and segregated, forming bright yellow and red mottles. The mottles observed in all but the well drained soils were formed by this alteration of iron, which is caused by a fluctuating water table. Accumulations of iron and manganese oxides are common in the somewhat poorly drained and very poorly drained soils. They occur as dark brown or black blotches on the faces of peds or as small, shotlike concretions.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Delta. An alluvial deposit, commonly triangular in shape, formed largely beneath water deposited at the mouth of a river or stream.

Depth to rock. Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, 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 classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The of unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stratified. Arrangement in strata, or layers. The term refers to geologic 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 aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.