United States
Department of
Agriculture

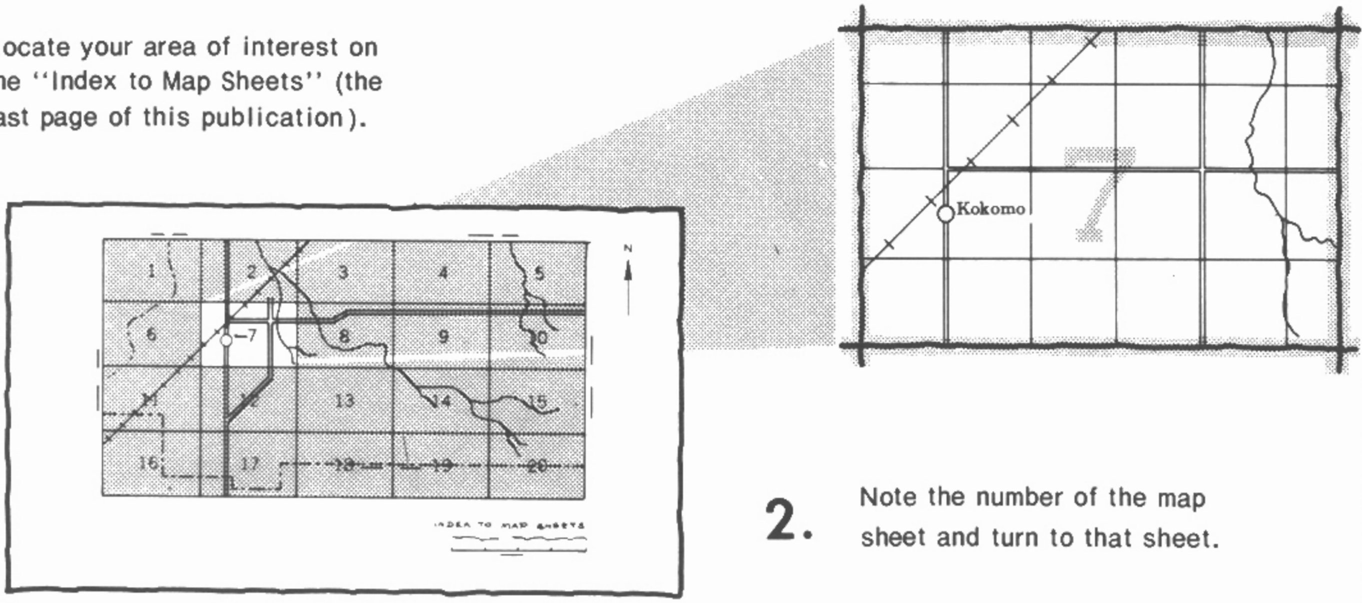
Soil
Conservation
Service

In Cooperation with
Ohio Department of
Natural Resources
Division of Lands and Soil
and Ohio Agricultural
Research and
Development Center

Soil Survey of Fulton County Ohio

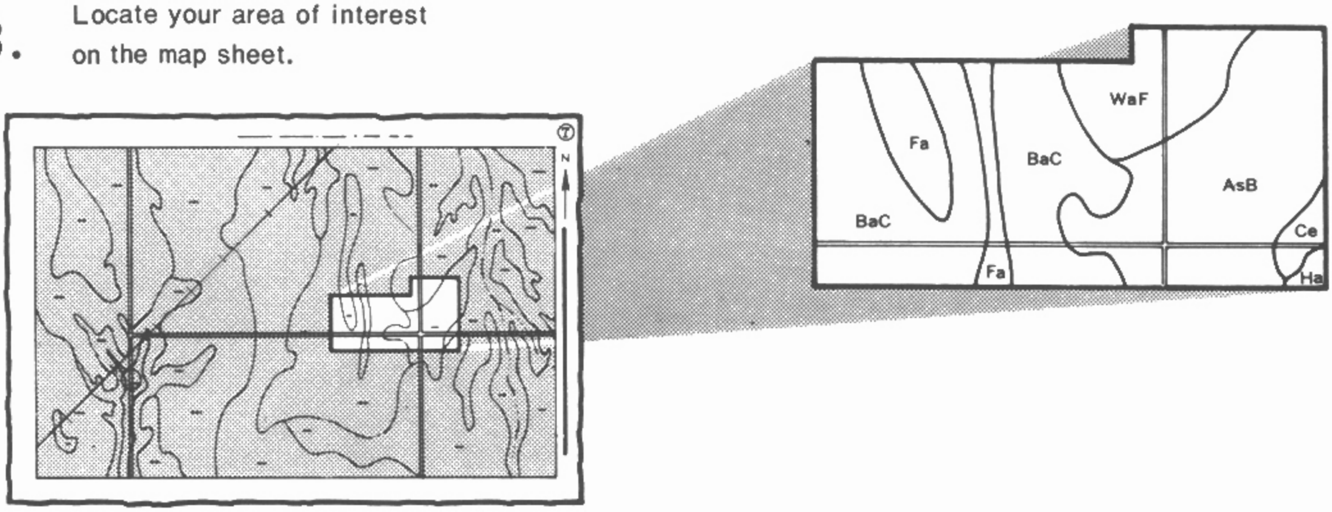
HOW TO US

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

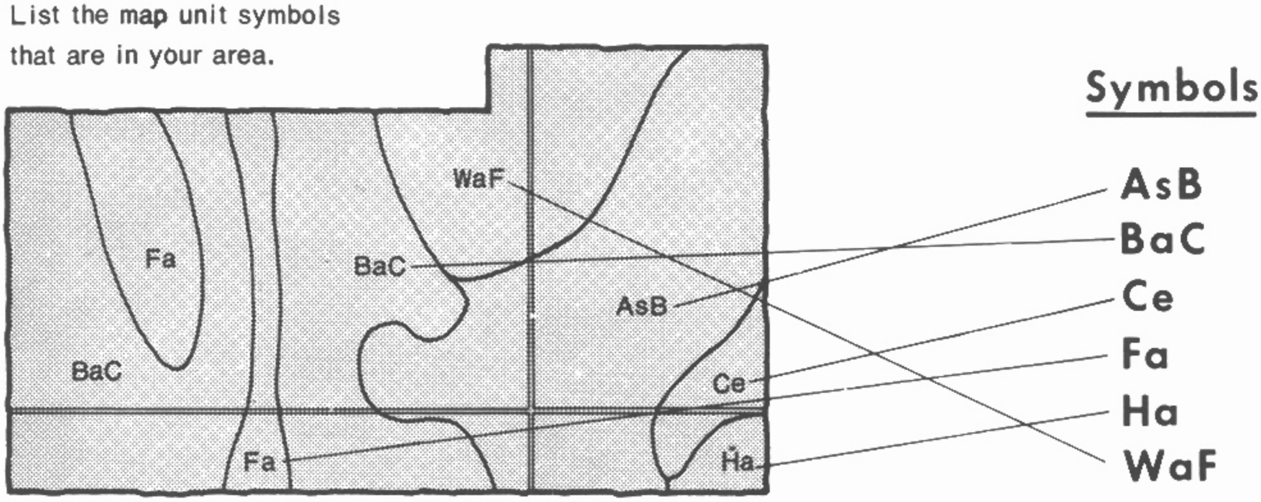


2. Note the number of the map sheet and turn to that sheet.

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

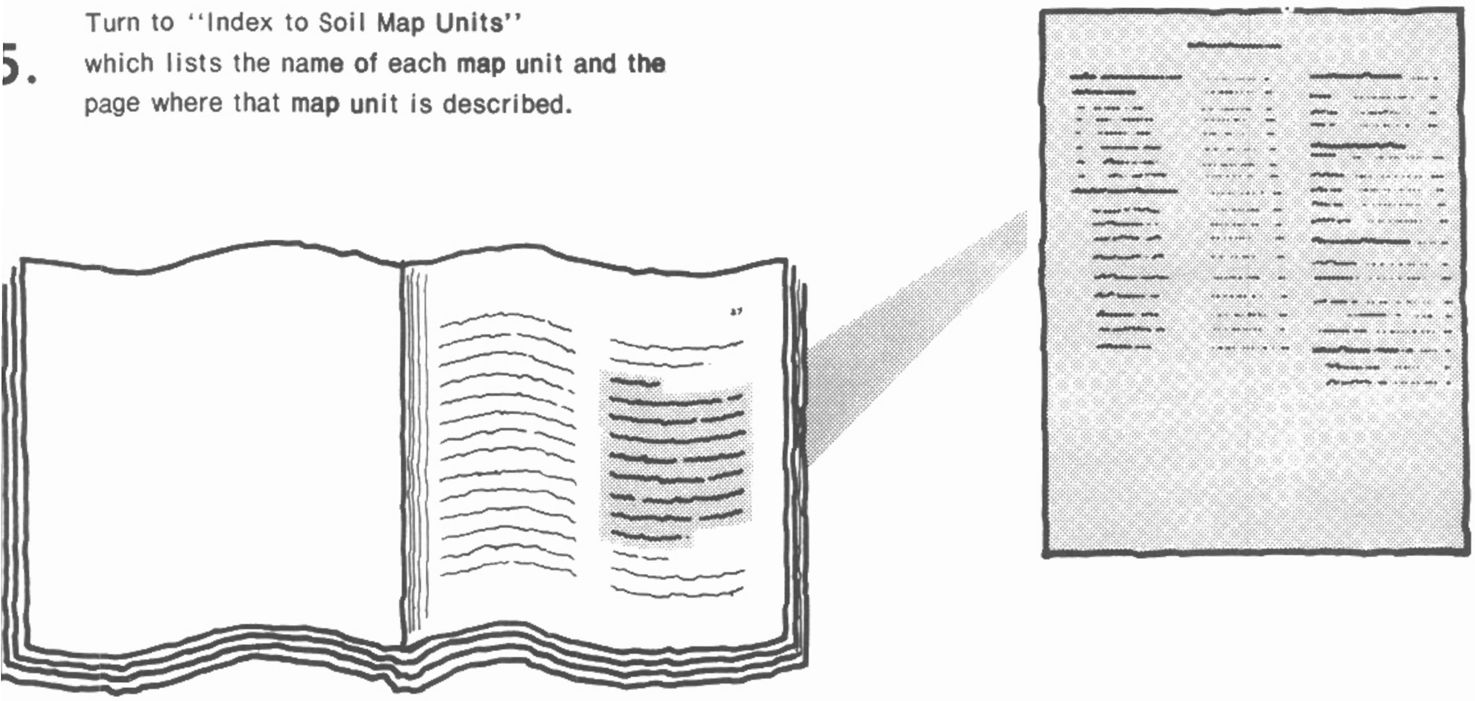


4. List the map unit symbols that are in your area.

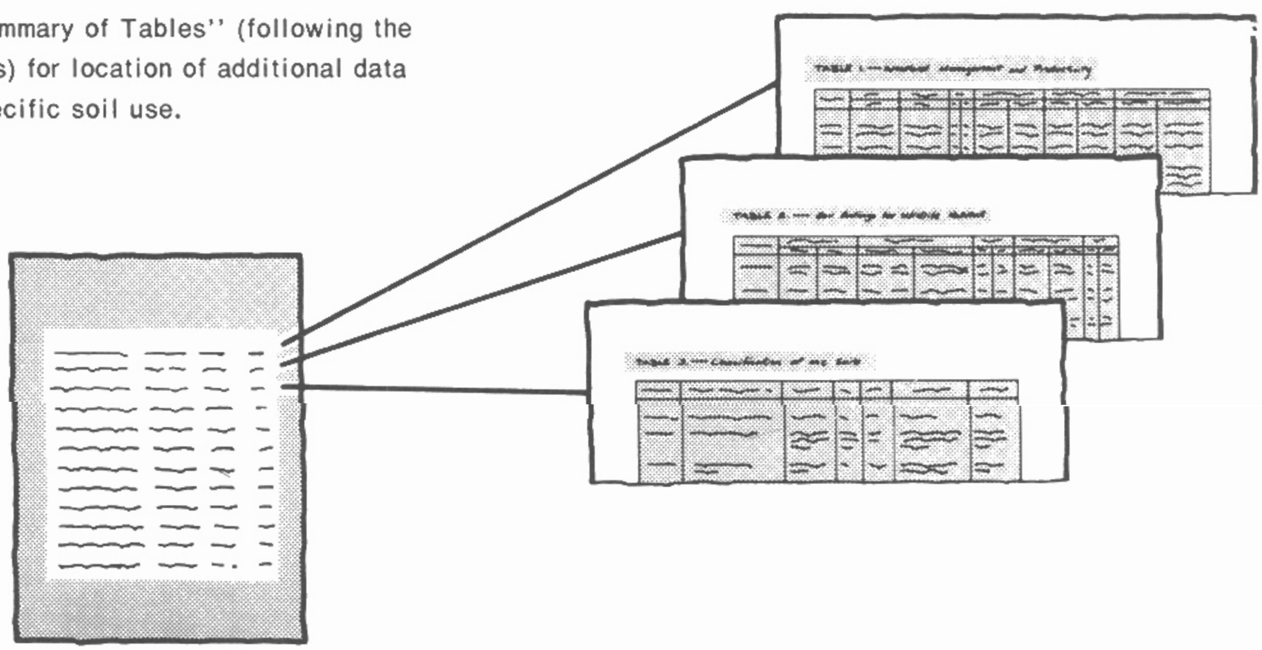


HIS SOIL SURVEY

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 Experiment Stations, 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 1975-1980. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. 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 was materially aided by funds provided by the Fulton County Commissioners. It is part of the technical assistance furnished to the Fulton Soil and Water Conservation District.

Cover: Colwood loam is well suited to soybeans.

contents

Soil Series

OCTOBER 1984

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Fulton County, Ohio. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as 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. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Robert R. Shaw
State Conservationist
Soil Conservation Service

Soil survey of Fulton County, Ohio

By K. L. Stone, Jr. and D.R. Michael, Soil Conservation Service

Fieldwork by K. L. Stone, Jr., D. R. Michael, G. D. Bottrell, E. H. McConoughey, and D. J. Crowner, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, In Cooperation With the Ohio Department of Natural Resources Division of Lands and Soil, and the Ohio Agricultural Research and Development Center

General Nature of the Survey Area

This section provides general information about the settlement; geology; water resources; physiography, relief, and drainage; climate; natural vegetation; agriculture; and transportation of Fulton County.

Fulton County is in the northwestern part of Ohio, along the Michigan border (fig. 1). It occupies about 407 square miles, or 260,288 acres. Wauseon, the county seat, is located in the south-central part of the county.

The first soil survey of Fulton County was published in 1922 (*7*). This survey updates the first survey and provides additional information and larger maps that show greater detail.

Settlement

The first settlements in the territory that is now Fulton County were started in 1833. They were at Phillips Corners, at Aetna, and along Bean Creek, in Franklin Township. They were also at Spring Hill in Dover Township, and along Delta and Swan Creeks. At this time many native Americans, mostly Pottowotomis, roamed and hunted game in the area.

Clearing trees and draining the wet soils were major accomplishments of the early settlers who prepared the land for farming.

Fulton County was formally organized on February 28, 1850. It became Ohio's 87th county. It was formed from parts of Lucas and Williams Counties, which contained land that was formerly owned by Michigan. Also, part of Fulton County came from Henry County. The county seat was originally Ottokee, but was later moved to Wauseon. The courthouse in Wauseon was completed in 1871 and still stands (*4, 5*).

Figure 1.—Location of Fulton County in Ohio.

There are several points of historical interest in the county today. They include the Howard Mansion and the Council Oak Tree at Winameg, the Historical Society Museum in Wauseon, and Sauder's Museum, north of Archbold.

Geology

The soils of Fulton County originated from glacial till and deposits in glacial lakes. Glacial deposits cover all of Fulton County. These deposits range mostly from 50 feet to 250 feet in thickness and are over shale bedrock.

Before the advent of several glacial advances, the area that makes up the present Fulton County was dissected by several stream valleys. These stream valleys tended to have a northern to northwestern orientation. Glacial deposits filled in these stream valleys. Local depth to bedrock tends to be deeper over these former stream valleys and shallower over former ridges.

Fulton County lies mostly within past glacial lake stages of the present-day Lake Erie. There were several different lake stages. These lake stages had a marked effect on the present surface geology. Several long, narrow beach ridges remain which formed along shorelines of these old lakes. Part of a large beach of a former lake remains in the southeastern part of the county and is known as the "Oak Openings." Deposits of lacustrine and deltaic sediments are mainly in the western part of the county from Archbold to just east of Fayette. Areas of glacial till that was reworked by lake action are in the eastern part of the county. They are located east of Lyons, around Metamora, north of Swanton, and southeast of Wauseon. Glacial end moraines are noticeable in the northwestern part of the county, near Fayette, and in the central part, from Wauseon through Oakshade to the Michigan line.

Postglacial streams, which include the Tiffin River, Mill Creek, Bean Creek, Bear Creek, and many others, eroded into the landscape and formed flood plains and valley slopes.

Water Resources

Both aerial photographs and topographic maps show numerous water areas in the county. The most important and largest of these is Harrison Lake, which is about 96 acres in size. Many smaller bodies of water are throughout the county. These include many small ponds, borrow pits that are filled with water, and impoundments that serve as reservoir storage for the towns and villages. About 200 acres of reservoir storage is used by the towns and villages for drinking water and fire protection. There is about 360 acres of small ponds and borrow pits that are filled with water and about 170 acres of open water along the Tiffin River and Bean Creek.

The Division of Water and Geological Survey of the Ohio Department of Natural Resources has made studies of the underground water supply (*12, 13, 14*). Most water sources are identified as seams or strata of sand and gravel in the glacial material. The underlying shale bedrock is not commonly a good source of water. In the Oak Openings, the shoreline of a former glacial lake, the main supply of ground water is in the sand, where water collects above the impervious glacial till.

A belt of artesian wells is on both sides of Tiffin River and Bean Creek and on the beach ridge that runs northeast-southwest through Fayette. Their capacity is about 500 to 1,000 gallons of water per minute.

Most of the water in the county has varying degrees of hardness and may contain some iron.

Physiography, Relief, and Drainage

Fulton County is made up of two major landforms: gently rolling terrain and nearly level plain. The landscape slopes gently eastward toward Lake Erie. The highest elevation in the county is in the northwestern part of the county and the lowest elevation is in the southeastern part.

The northwestern part of the county is characterized by gently rolling terrain. Slope increases around streams. Mill Creek, Deer Creek, and Iron Creek drain the northwestern rolling terrain into the Tiffin River.

The rest of the western part of the county is characterized by a nearly level plain. This area is drained by Bean Creek, Deer Creek, Iron Creek, Brush Creek, and Old Bean Creek into the Tiffin River. The Tiffin River flows southwest into the Maumee River.

The gently rolling and rolling terrain of the central part of the county has a complex drainage system that flows to the northeast, southwest, and southeast. Bear Creek flows northeast through Michigan into Lake Erie. Brush Creek drains southwest into the Tiffin River and Bad Creek, and North Turkeyfoot Creek drains southeast into the Maumee River.

The eastern part of the county is nearly level plain, except for the southeastern corner. Water is drained off to the east, northeast, and southeast. Little Bear Creek drains northeast through Michigan into Big Bear Creek. Ten Mile Creek drains east into Lake Erie. Ai Creek, Bad Creek, North Turkeyfoot Creek, and Swan Creek drain east and southeast into the Maumee River.

The southeastern corner of the county is characterized by undulating deposits of sand and is known as the Oak Openings. This area is drained by Swan Creek and Bad Creek east and southeast into the Maumee River.

Climate

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

Fulton County is cold in winter and warm and occasionally hot in summer. Precipitation is well distributed throughout the year but peaks moderately in summer. It is adequate for most crops on most soils.

Winter precipitation is mainly snow. It sometimes falls during high winds.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Wauseon, Ohio, in the period 1951 to 1978. 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 17 degrees. The lowest temperature on record, which occurred at Wauseon on January 24, 1963, is -19 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 29, 1952, is 100 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, 19 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 16 inches. The heaviest 1-day rainfall during the period of record was 4.01 inches at Wauseon on July 5, 1969. Thunderstorms occur on about 40 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 was 21 inches. On an average of 24 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 85 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 spring.

Severe thunderstorms occur occasionally; tornadoes are rare. Both are usually local, of short duration, and cause damage in a variable pattern. Climatic data for this section were especially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

Natural Vegetation

The natural vegetation of Fulton County is deciduous forest. The two major types of forest in the county are the oak forest type and the elm-ash swamp forest type.

The oak forest grows naturally in the Oak Openings, in the northwestern part of the county, and in the central part of the county. In this area northern red oak, white oak, sugar maple, black oak, and white ash are dominant. Basswood and shagbark hickory are scattered. A few swampy areas of grass also are scattered throughout this area.

The elm-ash swamp forest grows mainly in the Black Swamp, but it also is 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.

Agriculture

Agriculture is a major industry in Fulton County. In 1974, according to the Census of Agriculture of that year, 230,977 acres, or about 89 percent of the land area in the county, was farmland (*11*).

From 1969 to 1974, the number of farms decreased by about 300, but the average size of farms increased. Farms less than 179 acres in size decreased in number, while those that were 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 2 percent.

In 1974, about 95,533 acres was planted to corn, 63,373 to soybeans, 25,017 acres to wheat, 5,985 acres to hay, 1,284 acres to potatoes, and 2,347 acres to vegetables. There were 37,448 head of cattle and calves, 60,950 hogs and pigs, 1,494 sheep and lamb, 405 horses and ponies, and 416,606 chickens.

Transportation

Highways in the county consist of a network of all-weather roads. They include township and county roads, state and federal highways, and the Ohio Turnpike. Most of the roads are blacktopped. All communities are well serviced by interconnecting county and township roads.

Three major railroads cross the county. A county airport is north of Ottokee, and Toledo Express Airport is nearby, west of Toledo.

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, 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 Units" and "Detailed Soil Map Units."

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.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use of require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation to precisely define and locate the soil is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas called soil associations that have a distinctive pattern of soils, relief, and drainage. Each association on the general soil map is a unique natural landscape. Typically, a soil 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 units 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.

Soil Descriptions

Areas Dominated by Soils That Formed Mainly in Glacial Till

This group of three associations makes up about 31 percent of the county. The soils are dominantly nearly level to moderately steep and are very poorly drained, somewhat poorly drained, and moderately well drained. They formed in clayey, loamy, and silty glacial till on end moraines, ground moraines, and lake plains. These soils are used mainly for crops; however, seasonal wetness and erosion are the main limitations. The wetness and restricted permeability are limitations for building site development and sanitary facilities.

1. Hoytville-Nappanee Association

Nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in clayey and loamy glacial till reworked by water

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

This association makes up about 15 percent of the county. It is about 60 percent Hoytville soils, 21 percent Nappanee soils, and 19 percent minor soils (fig. 2).

Hoytville soils are very poorly drained. They are on broad, level flats and in poorly defined drainageways. Nappanee soils are somewhat poorly drained. They are nearly level and gently sloping and are on low rises and knolls.

Hoytville soils have moderately slow permeability in the subsoil and slow permeability in the substratum, moderate available water capacity, and high natural fertility. Nappanee soils have slow permeability, moderate available water capacity, and medium natural fertility. Both soils have a seasonal high water table near the surface. Hoytville soils are subject to ponding.

The minor soils in this association are the Haskins, Mermill, Rimer, and Seward soils. Mermill soils are very poorly drained. Haskins and Rimer soils are somewhat poorly drained. Seward soils are moderately well drained and are on low rises.

Hoytville and Nappanee soils are limited for many uses by the moderately slow or slow permeability and the wetness caused by the seasonal high water table. If these soils are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat. Tomatoes are the main specialty crop. The seasonal wetness and the moderately slow or slow permeability are severe limitations for many engineering uses.

2. Blount-Pewamo-Glynwood Association

Nearly level to moderately steep, somewhat poorly drained, very poorly drained, and moderately well drained soils that formed in loamy and silty glacial till

The soils in this association are on glacial ground moraines and end moraines. The Blount soils are nearly level to gently sloping, the Pewamo soils are nearly level, and the Glynwood soils are gently sloping to moderately steep. Some areas of more sloping soils are on sides of major drainageways.

This association makes up about 11 percent of the county. It is 30 percent Blount soils, 25 percent Pewamo soils, 15 percent Glynwood soils, and 30 percent minor soils.

Blount soils are somewhat poorly drained and are nearly level and gently sloping. They are in broad areas and on low rises. Pewamo soils are very poorly drained and are on flats and in poorly defined drainageways. Glynwood soils are moderately well drained and are on narrow ridges and convex knolls.

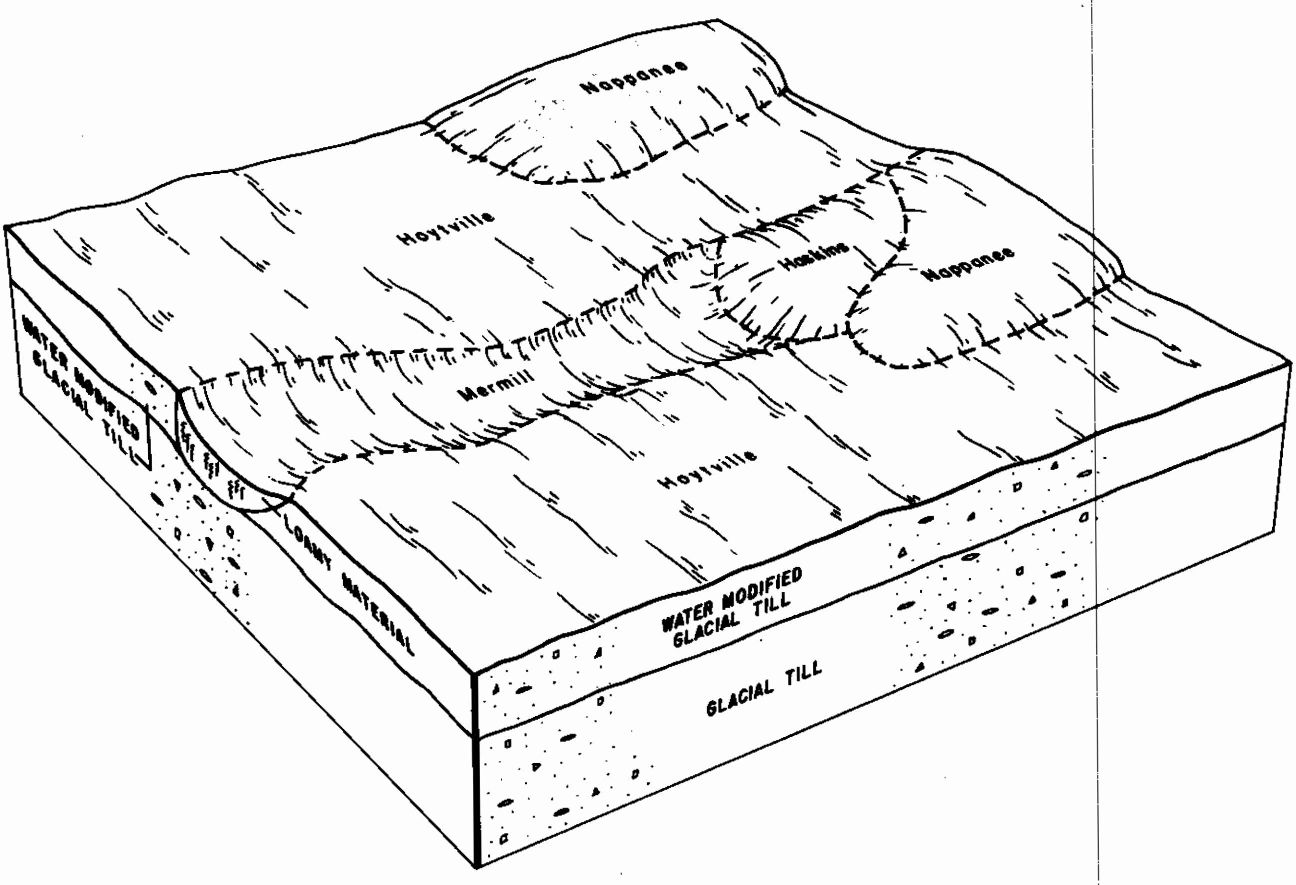


Figure 2.—Hoytville-Nappanee Association.

Blount soils have moderately slow or slow permeability, moderate available water capacity, and high natural fertility. Pewamo soils have moderately slow permeability, moderate or high available water capacity, and high natural fertility. Glynwood soils have slow permeability, a moderate available water capacity, and medium natural fertility. Blount and Pewamo soils have a seasonal high water table near the surface. Pewamo soils are subject to ponding. Glynwood soils have a seasonal high water table 2 to 3.5 feet below the surface.

The minor soils in this association are Haskins, Mermill, Rawson, Rimer, and Seward soils. Haskins and Rimer soils are somewhat poorly drained. Mermill soils are very poorly drained. Rawson and Seward soils are moderately well drained and on low rises and side slopes.

Blount, Pewamo, and Glynwood soils are limited for many uses by the moderately slow or slow permeability and the wetness caused by a seasonal high water table. Where Blount and Pewamo soils are adequately drained, they are well suited to crops. Glynwood soils need only random subsurface drainage to drain wet spots. The less sloping Glynwood soils are suited to crops. Major crops grown are corn, soybeans, and wheat. The seasonal wetness and the moderately slow or slow permeability are severe limitations for many engineering uses.

3. Hoytville-Blount Association

Nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in loamy glacial till reworked by water

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 nearly level; however, a few areas of more sloping soils are on the sides of major drainageways.

This association makes up about 5 percent of the county. It is about 55 percent Hoytville soils, 25 percent Blount soils, and 20 percent minor soils.

Hoytville soils are very poorly drained and are on broad, nearly level flats and in poorly defined drainageways. Blount soils are somewhat poorly drained and are nearly level. They are on low rises and low knolls.

Hoytville soils have moderately slow permeability in the subsoil and slow permeability in the substratum, moderate available water capacity, and high natural fertility. Blount soils have moderately slow or slow permeability, moderate available water capacity, and high natural fertility. Both soils have a seasonal high water table near the surface. Hoytville soils are subject to ponding.

The minor soils in this association are Haskins, Mermill, Rimer, Seward, Tedrow, and Brady soils. Haskins, Rimer, Tedrow, and Brady soils are somewhat poorly drained. Mermill soils are very poorly drained, and Seward soils are moderately well drained.

Hoytville and Blount soils are limited for many uses by the moderately slow or slow permeability and the wetness caused by the seasonal high water table. If the soils in this association are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat. These soils are severely limited for many engineering uses by the seasonal wetness and the moderately slow or slow permeability.

Areas Dominated by Soils on Lake Plains

This group of three associations makes up about 24 percent of the county. The soils are nearly level and gently sloping and are very poorly drained and somewhat poorly drained. They formed in clayey, silty, loamy, and sandy lake-laid sediment. They are on broad flats of an old glacial lake. These soils are used mainly for crops. Seasonal wetness is the main limitation for farming. The wetness and permeability are limitations to building site development and sanitary facilities.

4. Latty-Fulton Association

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

The soils in this association are on broad, flat lake plains. They are mainly nearly level to gently sloping; however, some areas of more sloping soils are on the sides of major drainageways.

This association makes up about 12 percent of the county. It is about 30 percent Latty soils, 25 percent Fulton soils, and 45 percent minor soils (fig. 3)

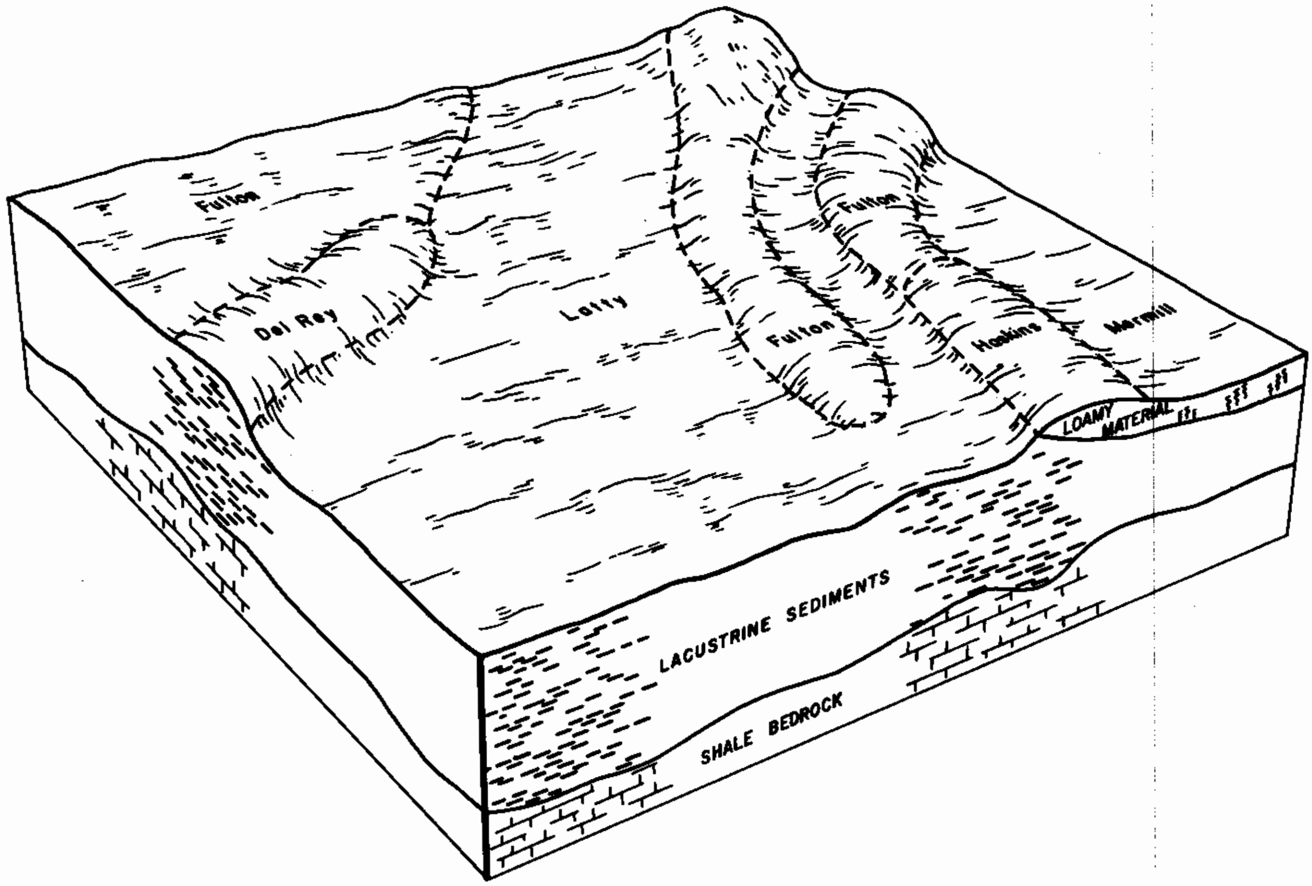


Figure 3.—Latty-Fulton Association.

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

Latty soils have slow permeability in the subsoil and very slow permeability in the substratum, moderate available water capacity, and medium natural fertility. Fulton soils have a slow or very slow permeability, moderate available water capacity, and medium natural fertility. Both soils have a seasonal high water table near the surface. Latty soils are subject to ponding.

The minor soils in this association are Del Rey, Haskins, Kibbie, Shinrock, Mermill, and Sloan soils. The Del Rey, Haskins, and Kibbie soils are somewhat poorly drained and on slight rises. Shinrock soils are moderately well drained and are on sides of drainageways. Mermill and Sloan soils are very poorly drained. Sloan soils are on narrow flood plains.

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

Where the soils in this association are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat. Tomatoes are the main specialty crop. These soils are severely limited for many engineering uses by the seasonal wetness and the slow or very slow permeability.

5. Lenawee-Del Rey Association

Nearly level, very poorly drained and somewhat poorly drained soils that formed in silty glacial lake sediment

The soils in this association are on broad, flat lake plains. They are mainly nearly level; however, some areas of sloping soils are on sides of major drainageways.

This association makes up about 6 percent of the county. It is about 30 percent Lenawee soils, 25 percent Del Rey soils, and 45 percent minor soils.

Lenawee soils are very poorly drained and are on broad flats and in poorly defined drainageways. Del Rey soils are somewhat poorly drained and are on broad flats and low rises.

Lenawee soils have moderately slow permeability, high available water capacity, and high natural fertility. Del Rey soils have slow permeability, moderate available water capacity, and high natural fertility. Both soils have a seasonal high water table near the surface. Lenawee soils are subject to ponding.

The minor soils in this association are the Haskins, Kibbie, Latty, Shinrock, Mermill, and Tuscola soils. The Haskins and Kibbie soils are somewhat poorly drained and are on low rises. The Latty and Mermill soils are very poorly drained. The Shinrock and Tuscola soils are moderately well drained and are on sides of major drainageways.

Lenawee and Del Rey soils are limited for many uses by 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.

Where the soils in this association are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat. These soils are limited for many engineering uses by the seasonal wetness and the slow or moderately slow permeability.

6. Colwood-Kibbie-Bixler Association

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

The soils in this association are on broad, flat lake plains. They are mainly nearly level; however, some areas of more sloping soils are on the sides of major drainageways and on beach ridges.

This association makes up about 6 percent of the county. It is about 30 percent Colwood soils, 25 percent Kibbie soils, 10 percent Bixler soils, and 35 percent minor soils.

Colwood soils are very poorly drained and are on broad flats or in poorly defined drainageways. The Kibbie and Bixler soils are in broad, nearly level areas and on narrow, irregular low rises.

Colwood soils have moderate permeability, high available water capacity, and high natural fertility. Kibbie soils have moderate permeability, high available water capacity, and high natural fertility. Bixler soils have rapid permeability in the upper part and moderate permeability in the lower part, moderate available water capacity, and medium natural fertility. Colwood and Kibbie soils have a seasonal high water table near the surface. The Bixler soils have a seasonal high water table in the subsoil. Colwood soils are subject to ponding.

The minor soils in the association are Dixboro, Lamson, Shinrock, and Tuscola soils. The Dixboro soils are somewhat poorly drained and are on low rises. The Lamson soils are very poorly drained and are on broad flats. The Shinrock and Tuscola soils are moderately well drained and are on sides of drainageways and on beach ridges.

Where the soils in this association are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat.

These soils are limited for many engineering uses mainly by 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 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.

Areas Dominated by Soils on Beach Ridges, Outwash Plains, and End Moraines

This group of four associations makes up about 42 percent of the county. These nearly level and gently sloping soils are very poorly drained, somewhat poorly drained, moderately well drained, and well drained. They formed in loamy and sandy material on broad flats, long and narrow ridges, and slight rises. These soils are used mainly for crops and as woodland. The seasonal wetness is the main limitation for crops, building site development, and sanitary facilities.

7. Ottokee-Granby-Tedrow Association

Nearly level and gently sloping, moderately well drained, very poorly 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 nearly level and gently sloping; however, some areas of more sloping soils are on the higher sandy ridges and on sides of major drainageways.

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

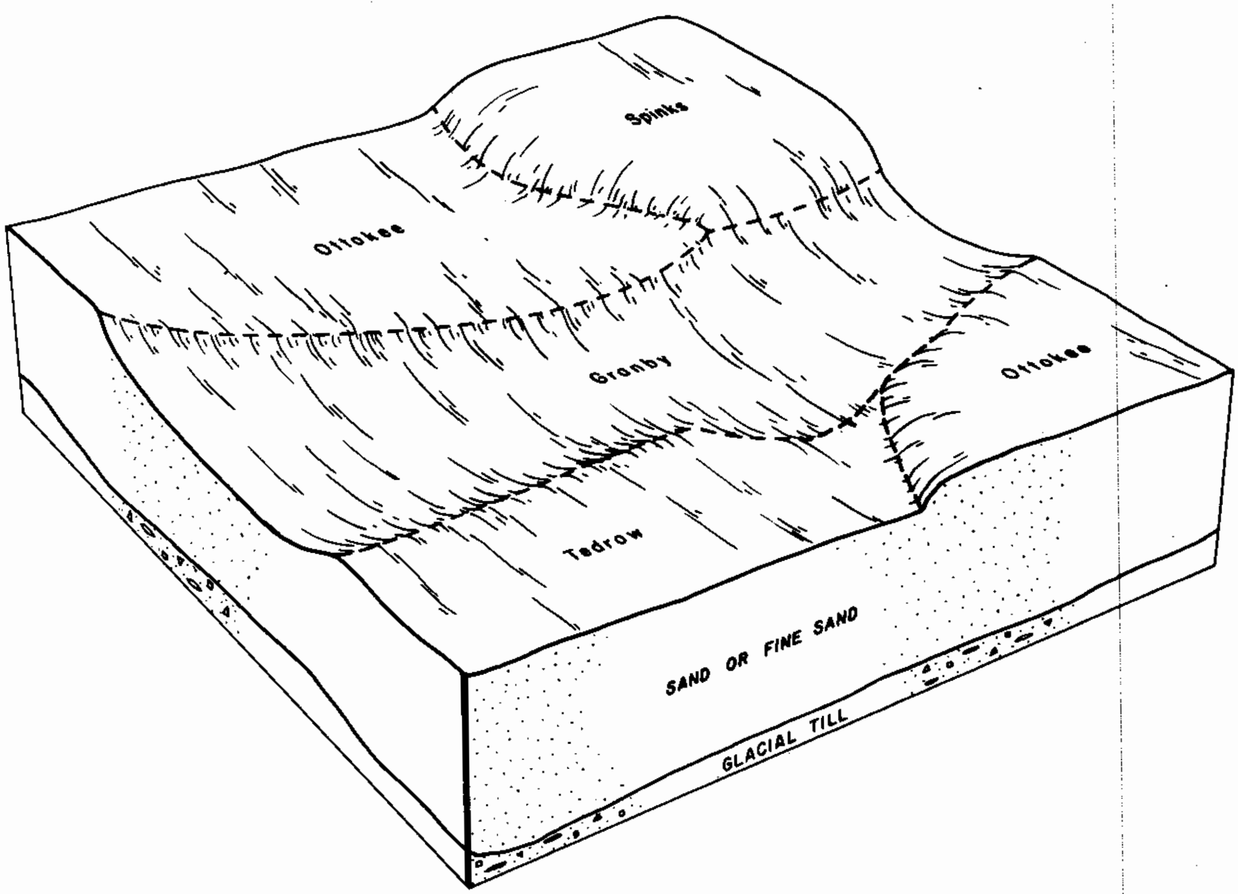


Figure 4.—Ottokee-Granby-Tedrow Association.

Ottokee soils are moderately well drained and are on narrow ridges and convex knolls. Granby soils are very poorly drained and are on broad, irregular flats and in poorly defined drainageways. Tedrow soils are somewhat poorly drained and are on low rises and knolls.

The soils of this association have rapid permeability and low available water capacity. Ottokee and Granby soils have medium natural fertility. Tedrow soils have low natural fertility. Ottokee soils have a seasonal high water table within a depth of 2 to 3.5 feet. Granby and Tedrow soils have a seasonal high water table near the surface. Granby soils are subject to ponding.

The minor soils in this association are Spinks, Gilford, Sloan, Glynwood, Tuscola, and Oakville soils. Spinks and Oakville soils are well drained and are on the higher ridges and on sides of major drainageways. Glynwood and Tuscola soils are moderately well drained and are on sides of higher ridges and major drainageways. Gilford soils are very poorly drained and are on low flats and in narrow drainageways. Sloan soils are very poorly drained and are on narrow flood plains.

Ottokee soils are limited for many uses by wetness, but they are droughty during extended dry periods. Granby and Tedrow soils are limited mainly by 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 and Tedrow soils are subject to wind erosion when they are dry and do not have an adequate vegetative cover. The soils of this association are suited to crops. 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.

8. Haskins-Blount-Oshtemo Association

Nearly level and gently sloping, somewhat poorly drained and well drained soils that formed in loamy, sandy, and gravelly outwash and loamy till

The soils of this association are on glacial till plains and beach ridges. They are mainly nearly level or gently sloping; however, some areas of more sloping soils are on the sides of beach ridges and drainageways.

This association makes up 2 percent of the county. It is about 30 percent Haskins soils, 20 percent Blount soils, 10 percent Oshtemo soils, and 40 percent minor soils.

Haskins and Blount soils are somewhat poorly drained and are on slight rises on and near beach ridges. Oshtemo soils are well drained and are on long, narrow beach ridges.

Haskins soils have moderate permeability in the upper part and slow or very slow permeability in the lower part. They have moderate available water capacity and high natural fertility. Blount soils have moderately slow or slow permeability, a moderate available water capacity, and high natural fertility. Oshtemo soils have moderately rapid permeability in the subsoil and very rapid permeability in the substratum, low available water capacity, and low natural fertility. Haskins and Blount soils have a seasonal high water table near the surface.

The minor soils in this association are Rawson, Spinks, Mermill, Gilford, Nappanee, Millgrove, Digby, and Perrin. Rawson and Perrin soils are moderately well drained. Spinks soils are well drained and on low ridges. Digby soils are somewhat poorly drained and nearly level. They are on rises. Gilford, Mermill, and Millgrove soils are very poorly drained and on irregular flats. Nappanee soils are somewhat poorly drained and on slight rises.

Haskins and Blount soils are limited for many uses by the slow or very slow permeability and the wetness caused by the seasonal high water table. Where these soils are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat. Oshtemo soils are suited to crops, but they are droughty during extended dry periods.

Haskins and Blount soils are limited for many engineering uses by wetness. Oshtemo soils are limited for septic tank absorption fields by the poor filtering capacity of the subsoil and the substratum. Haskins and Blount soils have low potential for recreation because of the seasonal wetness. Oshtemo soils are limited for recreation by the loamy sand surface layer.

9. Mermill-Haskins Association

Nearly level, very poorly drained and somewhat poorly drained soils that formed in loamy outwash deposited over loamy till or lacustrine deposits

The soils of this association are on outwash plains, till plains, and lake washed end moraines. They are mainly nearly level; however, some areas of more sloping soils are on sides of beach ridges and drainageways.

This association makes up about 18 percent of the county. It is about 30 percent Mermill soils, 15 percent Haskins soils, and 55 percent minor soils.

Mermill soils are very poorly drained and are nearly level. They are on broad flats and in poorly defined drainageways. Haskins soils are somewhat poorly drained and are on low rises and knolls.

Mermill and Haskins soils have moderate permeability in the surface layer and upper part of the subsoil and slow or very slow permeability in the lower part of the subsoil and substratum. They have moderate available water capacity and high natural fertility. Mermill and Haskins soils have a seasonal high water table near the surface. Mermill soils are subject to ponding.

The minor soils in this association are Blount, Boyer, Cohoctah, Digby, Gilford, Granby, Hoytville, Nappanee, Oakville, Oshtemo, Pewamo, Rimer, Seward, Spinks, Tedrow, and Wauseon soils. Blount, Digby, Nappanee, Rimer and Tedrow soils are somewhat poorly drained and on slight rises and knolls. Boyer, Oakville, Oshtemo, and Spinks soils are well drained and are on long, narrow beach ridges. Cohoctah soils are very poorly drained and are on flood plains of small streams. Gilford, Granby, Hoytville, Pewamo, and Wauseon soils are very poorly drained and on broad, irregular flats and in poorly defined drainageways. Seward soils are moderately well drained and are on slight rises.

Mermill and Haskins soils are limited for many uses by the slow or very slow permeability in the lower part of the subsoil and the substratum and the wetness caused by the seasonal high water table. Where these soils are adequately drained, they are well suited to crops. The main crops are corn, soybeans, and wheat. Tomatoes and cucumbers used for pickles are the main specialty crops.

The seasonal wetness and the slow to very slow permeability are severe limitations for many engineering uses. The soils are limited for recreation uses by the seasonal wetness.

10. Ottokee-Blount Association

Nearly level and gently sloping, moderately well drained and somewhat poorly drained soils that formed mainly in sandy material on beach ridges and in loamy glacial till

The soils in this association are in rolling areas where glacial till has been covered by lake sediment. These soils are mainly nearly level to gently sloping; however, some areas of more sloping soils are on sides of beach ridges and drainageways.

This association makes up about 7 percent of the county. It is about 30 percent Ottokee soils, 25 percent Blount soils, and 45 percent minor soils.

Ottokee soils are moderately well drained and gently sloping. They are in long narrow areas and on low knolls. Blount soils are somewhat poorly drained and are on low rises and knolls.

Ottokee soils have rapid permeability, low available water capacity, and medium natural fertility. Blount soils have moderately slow or slow permeability, moderate available water capacity, and high natural fertility. Ottokee soils have a seasonal water table at a depth of 2 to 3.5 feet, and Blount soils have a seasonal high water table near the surface.

The minor soils in this association are Adrian, Fulton, Galen, Gilford, Glynwood, Granby, Haskins, Mermill, Pewamo, Rawson, Rimer, Seward, Spinks, Tedrow, Tuscola, and Wauseon soils. Adrian soils are very poorly drained muck and are in pockets or depressions. Fulton, Haskins, Rimer, and Tedrow soils are somewhat poorly drained and on slight rises and knolls. Galen, Glynwood, Rawson, Seward, and Tuscola soils are moderately well drained and are on long, narrow side slopes and knolls. Gilford, Granby, Mermill, Pewamo, and Wauseon soils are very poorly drained and on broad, irregular flats and in poorly defined drainageways. Spinks soils are well drained and are on long, narrow ridges and side slopes.

Ottokee and Blount soils are limited for many uses by the wetness caused by the seasonal high water table. Blount soils are also limited by moderately slow or slow permeability. Where Blount soils are adequately drained, they are well suited to crops. Ottokee soils are suited to crops, but they are also limited by droughtiness during extended dry periods. The main crops are corn, soybeans, and wheat. The soils of this association are intermixed in a pattern that requires extra management.

The seasonal wetness of both soils and the moderately slow to slow permeability of the Blount soils are severe limitations for many engineering uses. The soils are limited for recreation by the seasonal wetness. Ottokee soils are also limited by the sandy surface layer.

Areas Dominated by Soils on Flood Plains and Outwash Plains

These two associations make up about 3 percent of the county. The soils are nearly level and are very poorly drained, somewhat poorly drained, and moderately well drained. They formed in loamy, silty, and sandy material of former outwash plains and present day flood plains. These soils are on broad, irregular flats and slight knolls. They are mainly used for crops and as woodland. The main limitations to cropping are seasonal wetness and the hazard of flooding. Flooding and seasonal wetness are also limitations for building site development and sanitary facilities.

11. Millgrove-Sloan-Brady Association

Nearly level, very poorly drained and somewhat poorly drained soils that formed in loamy, silty, sandy, and gravelly outwash and loamy alluvium

The soils of this association are on outwash plains and flood plains. They are mainly nearly level; however, some areas of more sloping soils are on the side slopes adjacent to the flood plain.

This association makes up about 2 percent of the county. It is about 40 percent Millgrove soils, 20 percent Sloan soils, 15 percent Brady soils, and 25 percent minor soils.

Millgrove and Sloan soils are very poorly drained and are on broad flats or in irregular, poorly defined drainageways. Sloan soils are on the flood plains, and Millgrove soils are on the outwash plains. Brady soils are somewhat poorly drained. They are on irregular, low rises and broad plains and terraces.

Millgrove soils have moderate permeability in the subsoil and moderately rapid permeability in the substratum, a moderate available water capacity, and high natural fertility. Sloan soils have moderate or moderately slow permeability, moderate or high available water capacity, and high natural fertility. Brady soils have moderately rapid permeability, moderate available water capacity, and low natural fertility. These soils have a seasonal high water table near the surface. The Millgrove soils are subject to ponding, and the Sloan soils are subject to flooding.

The minor soils in this association are Tedrow, Digby, Shoals, Ottokee, Kibbie, Gilford, and Del Rey soils. Tedrow, Digby, Kibbie, and Del Rey soils are somewhat poorly drained. Shoals soils are somewhat poorly drained and are subject to flooding. Ottokee soils are moderately well drained and are on low rises. Gilford soils are very poorly drained and are on broad flats.

These soils are limited for many uses by the wetness caused by a seasonal high water table. Sloan soils are also limited by frequent flooding. Where Millgrove and Brady soils are adequately drained, they are well suited to crops. Where protected and adequately drained, Sloan soils are also well suited to crops. The main crops are corn, soybeans, and wheat, but wheat may be damaged by flooding when grown on the Sloan soils.

These soils are limited for many engineering uses by wetness. The Sloan soils are also limited by flooding. The walls of shallow excavations tend to collapse, especially when the soil is wet. These soils have low potential for recreational uses because of the seasonal wetness.

12. Sloan-Shoals-Eel Association

Nearly level, very poorly drained, somewhat poorly drained, and moderately well drained soils that formed in silty and loamy recent alluvium

The soils in this association are on flood plains. They are mainly nearly level; however, in some areas side slopes are more sloping.

This association makes up about 1 percent of the county. It is about 35 percent Sloan soils, 25 percent Shoals soils, 15 percent Eel soils, and 25 percent minor soils.

The nearly level Sloan soils are very poorly drained and are on broad flats or in irregular drainageways. The nearly level Shoals soils are somewhat poorly drained and are on broad flats or slight rises. Eel soils are moderately well drained and are on slight rises and long, narrow ridges.

Sloan soils have moderate or moderately slow permeability, moderately high available water capacity, and high natural fertility. Shoals soils have moderate permeability, high or very high available water capacity, and high natural fertility. Both the Sloan and Shoals soils have a seasonal high water table near the surface. The Eel soils have a seasonal high water table at a depth of 3 to 6 feet. This association is subject to flooding.

Minor soils in this association are Del Rey, Shinrock, Tuscola, Fulton, Rimer, Seward, and Millgrove soils. Del Rey, Fulton, and Rimer soils are somewhat poorly drained and are on side slopes. Shinrock, Tuscola, and Seward soils are moderately well drained and are on the steeper side slopes. Millgrove soils are very poorly drained and on broad flats.

The soils of this association are suited to crops. The main crops are corn and soybeans.

These soils are limited for many engineering uses by frequent flooding and wetness. They are also limited for recreation by frequent flooding.

Detailed Soil Map Units

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, and gives the principal hazards and limitations to be considered in planning management for specific uses.

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, 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, Blount loam, 0 to 2 percent slopes, is one of several phases in the Blount series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

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. Blount-Rimer complex, 2 to 6 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.

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

Ad—Adrian muck. This nearly level, deep, very poorly drained soil is on outwash plains and in depressional areas of moraines (fig. 5). Slope is 0 to 2 percent and concave. Most areas range from 2 to 40 acres in size. Individual areas are long and narrow or oval. This soil receives runoff from adjacent higher lying soils and is subject to ponding.

Typically, the surface layer is black, very friable sapric material about 12 inches thick. The next layer is about 10 inches thick and is very dark grayish brown, friable sapric material. The substratum to a depth of about 60 inches is grayish brown, loose loamy fine sand. In some areas a calcareous silt loam is in the second layer. In other areas silty clay loam is below a depth of 40 inches.

Included with this soil in mapping are small elongated areas of Granby soils, which are sandy throughout. Also included, in some areas, are Mermill and Pewamo soils, which have more clay than the Adrian muck and are usually along the outer edge of the muck. These included soils make up about 15 percent of this mapped area.

Runoff is very slow on this Adrian soil, and ponding is common. Permeability is moderately rapid. The depth of the root zone depends on the depth of the water tables, but the root zone usually is moderately deep. The available water capacity is high. Reaction in the subsoil is medium acid to neutral. This soil has a seasonal high water table that is at the surface during wet periods.

Most of the acreage of this soil has been drained and is used for farming. Other areas are in marsh plants, including sedges, reeds, and grasses. This soil is suited to crops, hay, and pasture. The very poor natural drainage is the main limitation for farming. Where drained, soils are suited to corn, soybeans, hay and pasture. Subsurface drainage systems are commonly used to lower the water table where adequate outlets are available. Open ditches are also used to remove

Figure 5.—The dark area is Adrian muck, which is in an oval depression. Spinks soils are in the foreground, and Tedrow soils are in the background.

excess water. In many areas the soil has been drained to improve root penetration and to allow timely field operations. Ruts are caused by working the soil when wet. In ruts plant population is reduced because fewer seeds are embedded in the soil during planting. Livestock should be restricted from grazing during wet periods to prevent excessive damage to plants.

This soil is suited to trees and to habitat for wetland wildlife. Tree species that can tolerate wetness and ponding should be selected for planting. Tree harvesting equipment is limited by the wetness of the soil. Wetness of the soil increases seedling mortality and windthrow hazard. This soil is well suited to shallow water impoundments and wetland plants.

This soil is generally unsuited to building site development and septic tank absorption fields. A seasonal high water table, local ponding, low strength, and seepage are limitations for these uses.

This soil is in capability subclass IVw and woodland suitability group 4w.

BcA—Bixler loamy fine sand, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on outwash plains, beach ridges, and deltas. Individual areas are long and narrow on low ridges and oval on low knolls. Most areas range from 2 to 15 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 10 inches thick. The subsoil is about 20 inches thick. The upper part is yellowish brown and brownish yellow, very friable loamy fine sand. The middle part is brown, mottled, friable fine sandy loam. The lower part is brown, mottled, friable silt loam. The substratum to a depth of about 60 inches is light brownish gray, pale brown, and yellowish brown stratified silty and sandy material. It is mottled and friable.

Included with this soil in mapping are small areas of Tedrow and Ottokee soils, which are sandy throughout. Also included are areas of very poorly drained Colwood and Lamson soils, which are in drainageways and low spots. These inclusions make up about 15 percent of the mapped area.

Runoff is slow on this Bixler soil. Permeability is rapid in the upper sandy material and moderate in the lower part of the subsoil and in the substratum. Where drained, the soil has a deep root zone and moderate available water capacity. Reaction in the subsoil is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. A seasonal high water table is in the subsoil in winter, in spring, and in other extended wet periods. The organic matter content is moderately low.

Most areas of this soil are used for farming. Potatoes and other truck crops are grown where soil drainage has been improved. This soil is suited to corn, soybeans, wheat, oats, and hay and to pasture. Drainage and erosion are the main management concerns. Subsurface drainage systems are commonly used to lower the water table. When bare of vegetative cover, this soil is susceptible to wind erosion. Using conservation tillage that leaves crop residue on the surface and planting cover crops reduce wind erosion. If this soil is used for pasture, grazing should be restricted when the soil is wet to prevent damage to plants.

This soil is well suited to trees. Trees selected for planting should be tolerant of wetness. Seedling mortality and plant competition are two main concerns in managing woodland. Plant competition can be reduced by spraying, mowing, or disking. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds.

This soil is moderately well suited as a site for buildings, but it is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table. Buildings without basements are better suited to this soil than those with basements. Shallow excavations tend to slump, especially when the soil is wet. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. The lateral movement of water through the 20 to 35 inches of sandy material over loamy material is an added problem for buildings with basements. When the soil is bare of vegetation during construction, it is subject to wind erosion. Damage to local streets and roads from frost action can be reduced by providing artificial drainage and a suitable base material. Establishing and maintaining grass for lawns may be difficult because of droughtiness during the dry months. Wetness limits use for camp areas, picnic areas, and playgrounds.

This soil is in capability subclass IIw and woodland suitability group 2o.

BnA—Blount loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on ground moraines and end moraines. Individual areas are long and narrow on low ridges and broad on flats. Most areas range from 2 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part is dark yellowish brown, mottled, firm clay loam and clay, and the lower part is grayish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam.

Included with this soil in mapping are the very poorly drained Pewamo soils along drainageways and in low spots. Also included are moderately well drained Glynwood soils on higher knolls and breaks of slopes that parallel larger drainageways. Rimer soils, which are sandier in the surface layer and the upper part of the subsoil than this Blount soil, are in some areas. These inclusions comprise about 15 percent of most mapped areas.

Runoff is slow on this Blount soil. Permeability is moderately slow or slow. The root zone is mainly moderately deep to compact glacial till. The available water capacity is moderate. Reaction in the subsoil is strongly acid to slightly acid in the upper part and is medium acid to moderately alkaline in the lower part. The organic matter content is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet in winter, in spring, and in other extended wet periods.

Most areas of this soil are used for farming. The soil is well suited to corn, soybeans, wheat, oats, and hay and to pasture. Wetness delays planting and limits the choice of crops. Drainage is the main management concern. Subsurface drainage systems are commonly used to lower the water table. The soil becomes compacted when heavy machinery is used or livestock is grazed during wet periods. Grazing should be controlled. Planting cover crops and leaving crop residue on the surface improve tilth and increase water infiltration.

This soil is suited to trees and habitat for openland and woodland wildlife. Species selected for planting should be tolerant of some wetness. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or tunnels.

This soil is moderately well suited as a site for buildings, but it is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because the seasonal high water table and the moderately slow or slow permeability are limitations. Buildings without basements are better suited to this soil than those with basements. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Building sites and septic tank absorption fields should be landscaped and graded to provide good surface drainage. The water table can be lowered by subsurface drains around septic tank absorption field. Damage to local streets and roads from frost action and low strength can be reduced by providing artificial drainage and a suitable base material. Wetness limits recreational uses.

This soil is in capability subclass IIw and woodland suitability group 3c.

BnB—Blount loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on ground moraines and end moraines. It is on gentle rises of broad flats and on long, narrow ridges along drainageways. Most individual areas range from 3 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 10 inches thick. The subsoil is dark yellowish brown and dark grayish brown, mottled, firm clay loam about 15 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm clay loam. In a few areas the soil is moderately eroded and subsoil material has been mixed into the surface layer. In other areas the slope is slightly less than 2 percent or slightly more than 6 percent.

Included with this soil in mapping are the very poorly drained Pewamo soils in narrow areas along drainageways and in low spots. Also included are moderately well drained Glynwood soils on breaks of slopes that parallel larger drainageways. Rimer soils, which are sandier in the surface layer and the upper part of the subsoil than this Blount soil, are in some areas. These inclusions comprise about 15 percent of most mapped areas.

Runoff is medium on this Blount soil. Permeability is moderately slow or slow. The root zone is mainly moderately deep to compact glacial till. The available water capacity is moderate. Reaction of the subsoil is strongly acid to slightly acid in the upper part and is medium acid to moderately alkaline in the lower part. The organic matter content is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet in winter, in spring, and in other extended wet periods.

Most areas of this soil are used for crops. The soil is well suited to row crops and small grains and to hay and pasture (fig. 6). Soil erosion and drainage are the main management concerns. Using conservation tillage that leaves crop residue on the surface, planting cover crops, and using grassed waterways reduce soil loss. Subsurface drainage systems are commonly used to lower the water table. Grazing should be controlled to reduce soil compaction when the soil is soft because of wetness.

This soil is suited to trees and habitat for openland and woodland wildlife. Species selected for planting should be tolerant of some wetness. Seedling mortality and windthrow hazard are the main management concerns. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels.

This soil is moderately well suited as a site for buildings, but it is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because it has a seasonal high water table and moderately slow or slow permeability. Buildings without basements are better suited to this soil than those with basements. Buildings should be built so that surface water is directed away from foundations. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Building sites bare of vegetation are subject to erosion. Land shaping and seeding grass should be completed as soon as possible to reduce erosion. The water table can be lowered by subsurface drains around the septic tank absorption field. Damage to local streets and roads from frost action and low strength can be reduced by providing artificial drainage and using a suitable base material. Wetness limits recreational uses.

This soil is in capability subclass IIe and woodland suitability group 3c.

BoB—Blount-Rimer complex, 2 to 6 percent slopes. This map unit consists of gently sloping, somewhat poorly drained soils. Blount soils are on convex side slopes and part of the ridgetops. Rimer soils are on the ridgetops. Individual areas are oval on knolls and broad on ridges of the Defiance Moraine, which was reworked by lake water. They range from 2 to 40 acres in size. They are made up of 45 to 70 percent Blount soils and from 20 to 40 percent Rimer soils. Areas of the two soils are so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Blount soil has a surface layer of dark grayish brown, friable loam about 9 inches thick. The subsoil is dark yellowish brown and grayish brown, mottled, firm clay loam about 15 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm clay loam. In places the substratum is within 15 inches of the surface.

Typically, the Rimer soil has a surface layer of dark brown, friable loamy fine sand about 9 inches thick. The subsurface layer to a depth of 23 inches is yellowish brown, mottled, very friable fine sand. The subsoil is about 10 inches thick. The upper part is dark yellowish brown, mottled, very friable fine sandy loam. The lower part is grayish brown, mottled, firm clay. The substratum to a depth of about 60 inches is gray and dark yellowish brown, mottled, very firm silty clay loam. In some areas the surface layer is darker.

Figure 6.—Harvesting wheat on Blount loam, 2 to 6 percent slopes. This soil is well suited to row crops, small grains, hay, and pasture.

Included with these soils in mapping are small areas of Fulton, Kibbie, Seward, and Tedrow soils. Fulton soils are somewhat poorly drained lacustrine clay and silty clay and are on side slopes. Seward soils are moderately well drained and are on ridgetops. Kibbie soils formed in stratified silts and fine sands and are on side slopes. Tedrow soils are sandy to a depth of more than 40 inches and are on ridgetops. Included soils make up 10 to 25 percent of most mapped areas.

Surface runoff is medium on the Blount soil and slow on the Rimer soil. Permeability is moderately slow or slow in the Blount soil. In the Rimer soil it is rapid in the surface layer and the upper part of the subsoil and slow or very slow in the lower part and in the substratum. A seasonal high water table is at a depth of 1 foot to 3 feet in the Blount soil and 1 foot to 2.5 feet in the Rimer soil in winter, in spring, and in other extended wet periods. The available water capacity is moderate. The root zone is mainly moderately deep to compact glacial till. Reaction in the subsoil of the Blount soil is strongly acid to slightly acid in the upper part and medium acid to moderately alkaline in the lower part. Reaction in the subsoil of the Rimer soil is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The organic matter content in the surface layer is moderate in the Blount soil and moderately low in the Rimer soil.

Most areas of these soils are used for farming. These soils are well suited to row crops and pasture. Soil erosion and drainage are the main management concerns. Using conservation tillage that leaves crop residue on the surface, planting cover crops, and using grassed waterways reduce soil loss by water and wind. Wind erosion is a problem on the Rimer soil after it is cultivated and before the new crop is large enough or dense enough to protect the surface. Subsurface drainage systems are commonly used to lower the water table. Wet spots generally are between the Blount and Rimer soils. Equipment frequently becomes stuck in these areas. Proper cultivation and planting seed at the right depth are problems because of the abrupt changes in surface texture. Controlled grazing should be used to reduce excessive soil compaction and damage to plants.

A few areas are used as woodland. These soils are suited to trees and habitat for openland and woodland wildlife. Tree species that can tolerate wetness should be selected for new plantings. Improving woodland for timber production requires exclusion of grazing livestock and removal of undesirable species and poorly formed trees.

These soils are moderately well suited as a site for buildings, but they are limited by a seasonal high water table. They are poorly suited to septic tank absorption fields because of the seasonal high water table and the moderately slow or slow permeability in the Blount soils and the slow or very slow permeability in the lower part of the subsoil and in the substratum of the Rimer soils. Buildings without basements are better suited to these soils than buildings with basements. Buildings without basements should have footings that are sunk into the substratum. Because the subsoil settles at different rates in the Blount and Rimer soils, walls can crack in buildings that span both soils. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. In Rimer soils the lateral movement of water through 20 to 35 inches of sandy material over the clayey material is an added problem for buildings with basements. Building sites bare of vegetation are subject to water erosion on Blount soils and wind erosion on Rimer soils. Land shaping and seeding grass should be completed as soon as possible to reduce soil loss. If this soil is used for septic tank absorption fields, the water table can be lowered by subsurface drains. The absorption field should be landscaped and graded so that surface water is diverted from leach lines. Lateral movement of water in the Rimer soil may cause seep spots on side slopes. Damage to local streets and roads from frost action and low strength can be reduced by providing artificial drainage and a suitable base material. Wetness limits recreational uses.

This complex is in capability subclass IIe. The Blount soil is in woodland suitability group 3c, and the Rimer soil is in woodland suitability group 2s.

BrB—Boyer loamy sand, 1 to 6 percent slopes. This gently sloping, well drained soil is on outwash plains, moraines, and beach ridges. Individual areas on ridges are long and narrow, and those on low knolls are oval. The areas range from 2 to 20 acres.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil extends to a depth of about 30 inches. It is yellowish brown and brown, friable loamy sand, sandy loam, and coarse sandy loam. The substratum to a depth of about 60 inches is pale brown gravelly sand.

Included in mapping are small areas of the sandy Spinks soils and a soil that contains more clay in the surface layer and subsoil than this Boyer soil. Also included are small areas of Oshtemo soils, which are deeper to the substratum than the Boyer soil. The included soils make up about 15 percent of the map unit.

Runoff is slow on this Boyer soil. Permeability is moderately rapid in the surface layer and the subsoil and very rapid in the substratum. The root zone is deep, and the available water capacity is low. The organic matter content is moderately low. Reaction in the subsoil is medium acid in the upper part and medium acid to mildly alkaline in the lower part. 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 for crops. Droughtiness is the main limitation if this soil is used for crops and 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. Using conservation tillage that leaves crop residue on the surface and planting cover crops reduce soil loss. Returning crop residue to the plow layer or adding other organic material helps reduce wind erosion and delay the drying of the surface soil. If this soil is used for pasture, grazing should be restricted when the soil is too dry. Because of the looseness of the surface soil, overgrazing reduces the plant population.

The 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 well suited as sites for buildings. It is moderately well suited to septic tank absorption fields. It is limited by the poor filtering capacity of the sands and the chance of ground water pollution. The walls of shallow excavations tend to collapse. If this soil is dry and bare of vegetation, it is subject to wind erosion. Establishing and maintaining grass for lawns is difficult because this soil is droughty. Small stones are a moderate limitation for camping and picnic areas and a severe limitation for playgrounds.

This soil is in capability subclass IIIs and woodland suitability group 3s.

ByA—Brady sandy loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is mainly on outwash plains, terraces, and beach ridges. Individual areas on low ridges are long and narrow, and those on low knolls are oval. The areas range from 2 to 20 acres.

Typically, the surface layer is friable dark brown sandy loam about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark brown and yellowish brown, mottled, very friable sandy loam. The middle part is brown, mottled, very friable sandy loam. The lower part to a depth of about 60 inches is light brownish gray and brown loamy sand.

Included in mapping are small areas of the sandy Tedrow soils and the very poorly drained Millgrove and Gilford soils, which are in low parts of the landscape and along drainageways. Also included is a soil that has clayey texture below a depth of 35 inches. These included soils make up about 15 percent of this map unit.

Runoff is very slow on this Brady soil. Permeability is moderately rapid. The organic matter content is moderate. The root zone is deep, and the available water capacity is moderate. Reaction in the subsoil is medium acid to neutral. A seasonal high water table is near the surface during extended wet periods.

In most areas this soil is used for crops. The soil is suited to row crops and to pasture. Drainage is the main management concern if this soil is used for crops or pasture. Subsurface drainage systems are commonly used to lower the water table where adequate outlets are available. Most areas have been drained to improve plant growth and to make cultivation easier. The hazards of wind erosion and droughtiness are also management concerns during dry periods. Wind erosion is a problem in the spring when the ground is dry and has been tilled for planting. Crop residue on the surface of the soil reduces the erosive effects of the wind. This soil becomes droughty during long dry spells in the summer. Livestock should be restricted from grazing during wet periods to prevent excessive damage to plants.

This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings, but it is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table. The water table can be lowered by subsurface drains. Buildings without basements are better suited to this soil than those with basements. The walls of shallow excavations tend to slump, especially when the soil is wet. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. If this soil is dry and bare of vegetation, it is subject to wind erosion. Damage to local streets and roads from frost action can be reduced by providing artificial drainage and using a suitable base material. Establishing and maintaining grass for lawns may be difficult because of droughtiness during the dry months. Wetness limits recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2o.

Ch—Cohoctah fine sandy loam, frequently flooded. This nearly level, very poorly drained soil is on flood plains of streams. It is subject to frequent flooding. It is on broad flats of the smaller flood plains and in narrow, elongated strips along drainageways in the larger flood plains. Slope is 0 to 2 percent. Individual areas range from 5 to 50 acres in size.

Typically, this soil has a surface layer of very dark grayish brown, friable fine sandy loam about 12 inches thick. The substratum to a depth of 60 inches is grayish brown, mottled, friable fine sandy loam and loamy fine sand. In some areas gravel is in the lower part of the substratum.

Included with this soil in mapping are small areas of somewhat poorly drained Shoals soils on slight rises. This included soil makes up about 10 percent of this map unit.

Runoff is very slow on the Cohoctah soil. Permeability is moderately rapid. The root zone is deep, and the available water capacity is moderate or high. The substratum is neutral or mildly alkaline. This soil has a seasonal high water table at the surface during extended wet periods. The organic matter content is high.

Most areas of this soil are used for farming and as woodland. This soil is limited by flooding and wetness. Drainage is commonly hindered by lack of adequate outlets and by duration of flooding. This soil is suited to most crops, but winter wheat may be damaged by flooding and ponding. Corn and soybeans can often be grown, but flooding may delay planting. Also, logs, branches, and other flooding debris commonly are a hazard to farming. This soil is well suited to pasture, but grazing when the soil is wet causes compaction and lowers the plant population.

This soil is suited to growing trees. Species selected for planting should be tolerant of wetness. During wet seasons, use of tree harvesting equipment commonly is limited by wetness and flooding. Delaying harvesting of trees until the dry times of the year overcomes this problem.

This soil is generally unsuited as sites for buildings and septic tank absorption fields because of the seasonal high water table and frequent flooding. Shallow excavations tend to slump especially when wet. Local streets and roads are subject to damage by frost action, the seasonal high water table, and flooding. Constructing streets and roads on raised, well compacted fill material and providing adequate side ditches and culverts will protect them. Frequent flooding and wetness also limit recreational uses of the soil.

This soil is in capability subclass IIIw and woodland suitability group 2w.

Cn—Colwood loam. This nearly level, very poorly drained soil is on outwash plains and deltas. It is in low, slight depressions and in broad areas on flats. Slope is 0 to 2 percent. Individual areas range from 3 to 70 acres. This soil receives runoff from adjacent higher lying soils and is subject to ponding.

Typically, the surface layer is very dark gray, friable loam about 10 inches thick. The subsoil is grayish brown and gray, mottled, firm clay loam and silty clay loam about 32 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled, firm stratified very fine sandy loam, silt loam, and silty clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Dixboro and Kibbie soils on small knolls. Also included are areas of Lamson soils, which have more sand in the subsoil than the Colwood soil, and Lenawee soils, which have more clay in the subsoil. These included soils make up about 15 percent of this map unit.

Runoff is very slow, or this Colwood soil is ponded. Permeability is moderate. The root zone is deep, and the available water capacity is high. Reaction in the subsoil is slightly acid to mildly alkaline. The organic matter content is high. This soil has a water table at or near the surface during extended wet periods.

Most areas of this soil are used as cropland. The soil is well suited to corn, soybeans, wheat, and pasture. Drainage is the major management concern if this soil is used for crops and pasture. Subsurface drainage is commonly used to lower the water table, where adequate outlets are available. Local ponding after heavy rains may lower crop yields. Returning crop residue to the plow layer helps to maintain the organic matter content. This soil is suited to a variety of pasture grasses. Grazing should be restricted when the soil is wet to reduce 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 wet. Plant competition can be reduced by spraying, mowing, or disking. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of the seasonal high water table and local ponding. Buildings without basements are better suited to this soil than those with basements. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. The walls of shallow excavations tend to slump, especially when wet. The water table can be lowered by installing subsurface drains around septic tank absorption fields. Damage to local street and roads from frost action and ponding can be reduced by installing artificial drainage and by using a suitable base material. Seasonal ponding and wetness also limit recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2w.

DfA—Del Rey silt loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is mostly on deltas and outwash plains. Individual areas are long and narrow on low ridges and oval on convex, low knolls. Most areas range from 3 to 30 acres in size.

Typically, the surface layer is dark grayish brown, firm silt loam about 10 inches thick. The subsoil is about 31 inches thick. The upper part is light olive brown, mottled, firm silty clay loam. The lower part is grayish brown and gray, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is gray and dark yellowish brown, mottled, firm stratified silty clay loam and silt loam. In some places this soil has a surface layer of loam.

Included with this soil in mapping are small areas of the very poorly drained Lenawee soils along drainageways and in slight depressions. Also included are small areas of the somewhat poorly drained Kibbie soils that contain less clay in the subsoil. In some areas there is a soil that has a substratum of stratified silt and sand. These inclusions make up about 15 percent of most mapped areas.

Runoff is slow on this Del Rey soil. Permeability is slow in the subsoil. In drained areas the soil has a deep root zone and moderate available water capacity. Reaction in the subsoil is medium acid or neutral in the upper part and neutral to moderately alkaline in the lower part. A seasonal high water table is at a depth of 1 foot to 3 feet in winter, in spring, and in other extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the principal crops. The soil is well suited to crops and pasture. Wetness is the main management concern when it is used as cropland. Subsurface drainage is sufficient for most agricultural drainage needs. Leaving a rough seedbed and adding organic matter to the plow layer reduce surface crusting. Livestock should be restricted from grazing during wet weather to prevent excessive soil compaction. The use of cover crops and crop residue helps control erosion, improve tilth, and increase water infiltration.

This soil is suited to growing trees. Improving woodland for timber production requires the exclusion of livestock and the removal of undesirable species and poorly formed trees. Seedling mortality and windthrow hazard are the main management concerns. Seedling mortality can be reduced by mulching, by planting during the spring when the moisture supply is best, by assuring good compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting practices that produce straight borders that do not result in wind pockets or wind tunnels.

This soil is moderately well suited as a site for buildings, but is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table and slow permeability. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Building sites and septic tank absorption fields should be landscaped and graded to divert surface water from foundations and leach lines. The water table can be lowered by installing subsurface drains around septic tank absorption fields. Local streets and roads are severely limited by low strength and frost action, which can be reduced by providing a suitable base material and by artificial drainage. If reservoirs are dug in the included soils that have a substratum of stratified silt and sand, seepage is a possibility. A blanket of clayey material covering the sides and bottom helps seal these reservoirs. Wetness also limits recreational uses of this soil.

This soil is in capability subclass IIw and woodland suitability group 3c.

DmA—Digby loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is mainly on outwash plains, terraces, and beach ridges. Individual areas on low ridges are long and narrow, and those on low knolls are oval. They range from 2 to 15 acres.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil extends to a depth of about 32 inches. It is dark yellowish brown and yellowish brown, mottled, friable clay loam and sandy loam. The substratum to a depth of about 60 inches is dark grayish brown gravelly loamy coarse sand. In some areas the surface layer is somewhat darker than is typical.

Included with this soil in mapping are small areas of Haskins soils, which have clayey material within a depth of 40 inches. Also included are areas of the very poorly drained Millgrove soils in low parts of the landscape and along drainageways. These included soils make up about 15 percent of this map unit.

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

Most areas of this soil are used for crops. The soil is well suited to crops and pasture. Wetness delays planting and limits choice of crops. Drainage is the main management concern. Subsurface drainage systems are commonly used to lower the water table. Erosion by water is a hazard in the more sloping areas. Using cover crops and returning crop residue to the plow layer help control erosion, improve tilth, and increase water infiltration. The soil becomes compacted when heavy machinery is used or livestock is grazed during wet periods. Controlled grazing should be used.

This soil is well suited to trees. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table and the poor filtering capacity of the sandy and gravelly material. Buildings without basements are better suited to this soil than those with basements. The walls of shallow excavations tend to slump, especially when wet. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. If this soil is used for septic tank absorption fields, ground-water pollution is a hazard. The water table can be lowered by subsurface drains. The use of this soil for local streets and roads is severely limited by frost action, which can be reduced by installing artificial drainage and using a suitable base material. Wetness limits recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2o.

DtA—Dixboro fine sandy loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on outwash plains and deltas. Individual areas are long and narrow on low ridges and oval on low knolls. They range from 2 to 15 acres.

Typically, the surface layer is dark brown, very friable fine sandy loam about 9 inches thick. The subsoil extends to a depth of about 39 inches. It is yellowish brown, mottled, friable fine sandy loam and loam in the upper part and dark yellowish brown and brown, mottled, friable and firm fine sandy loam and silt loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified very fine sandy loam and silt loam that is mottled and friable.

Included with this soil in mapping are small areas of very poorly drained Colwood and Lamson soils in drainageways and low, wet spots. Also included, southeast of Fayette, along the old channel of Bean Creek, are a few areas of Bixler soils that contain more sand in the lower part of the subsoil and in the substratum. These included soils make up about 15 percent of this map unit.

Runoff is slow on the Dixboro soil. Permeability is moderate. Where this soil has been drained, the root zone is deep and the available water capacity is moderate or high. The organic matter content is moderate. Reaction in the subsoil is medium acid to mildly alkaline. The water table is near the surface during extended wet periods.

In most areas this soil is used for crops. This soil is well suited to corn, soybeans, and wheat and to hay and pasture. Potatoes and other specialty crops are also grown on this soil. Drainage is the main management concern. Subsurface drainage is commonly used to lower the water table. When dry and bare of vegetative cover, this soil is susceptible to wind erosion. Planting cover crops and leaving crop residue on the surface help control erosion, improve tilth, and increase water infiltration. Controlled grazing should be used to reduce soil compaction and protect plant population when the soil is wet.

This soil is well suited to growing trees. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table. Buildings without basements are better suited to this soil than those with basements. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Walls of shallow excavations tend to slump, especially when wet. The water table can be lowered by installing subsurface drains around septic tank absorption fields. The use of this soil for local streets and roads is severely limited by frost action, which can be reduced by installing artificial drainage and using a suitable base material. Wetness also limits recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2o.

Ee—Eel silt loam, frequently flooded. This nearly level, moderately well drained soil is on flood plains. It is subject to frequent flooding. The soil is in elongated strips or small areas on convex slopes along the major creeks and rivers. Slope is 0 to 2 percent. Most individual areas range from 2 to 10 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The upper part of the substratum to a depth of about 19 inches is dark yellowish brown, friable silt loam. The middle part to a depth of about 34 inches is dark yellowish brown and dark brown, mottled, friable silt loam. The lower part to a depth of about 60 inches is dark grayish brown, mottled, friable and firm silty clay loam. In some areas the surface layer is sandier, and in some areas it is very dark grayish brown.

Included with this soil in mapping are areas of somewhat poorly drained Shoals soils and very poorly drained Sloan soils, which are in drainageways and lower lying parts on the flood plain. Also included are areas of well drained soils on slightly higher ridges. Included soils make up about 10 percent of this map unit.

Runoff is slow on the Eel soil. Permeability is moderate. The root zone is deep. Available water capacity is high or very high. Reaction in the substratum is slightly acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. This soil has a seasonal high water table that is 3 to 6 feet below the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for crops or as woodland. The soil is well suited to crops and pastures. Flooding is the main management concern, but wetness is also a limitation. Corn and soybeans are the major crops grown, but flooding may delay planting. Winter wheat may be damaged by flooding. This soil is well suited to pasture, but it should not be grazed when it is wet to avoid compaction and damage to plants.

This soil is well suited to growing trees. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is generally unsuited as sites for buildings and septic tank absorption fields because of flooding. Constructing streets and roads on raised, well compacted fill material and providing adequate side ditches and culverts help protect them from flooding. Frequent flooding also limits the use of this soil for camp areas and playgrounds.

This soil is in capability subclass IIw and woodland suitability group 1o.

FtA—Fulton silty clay loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on the lake plain and on deltas. It is on slight, convex rises and in broad areas on flats. Most individual areas range from 2 to 20 acres in size.

Typically, this soil has a surface layer of dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 19 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam; the lower part is yellowish brown and dark yellowish brown, mottled, very firm silty clay. The substratum to a depth of about 60 inches is dark yellowish brown, stratified silty clay and silty clay loam that is mottled and very firm.

Included with this soil in mapping are very poorly drained Latty soils, which are in narrow drainageways and low spots. Also included are small areas of a soil that is more sloping than this Fulton soil and small areas of Haskins soils, which contain less clay than the Fulton soil. Included soils make up about 15 percent of this mapped unit.

Runoff is slow on this Fulton soil. Permeability is slow or very slow. When adequately drained, this soil has a deep root zone and moderate available water capacity. The subsoil is medium acid to mildly alkaline. This soil has a seasonal high water table that is near the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for farming. This soil is suited to crops and pasture. Drainage is the main management concern. Subsurface drainage is commonly used to lower the water table. The surface layer of this soil crusts after heavy rains, which slows plant emergence and slows air and water movement into the soil. Controlled grazing should be used when the soil is wet to reduce soil compaction. Using cover crops and returning crop residue to the plow layer help control erosion, improve tilth, and increase water infiltration.

This soil is suited to growing trees. Species being planted should be tolerant of some wetness. Seedling mortality and windthrow hazard are the main management concerns. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind tunnels or wind pockets.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table and high shrinking and swelling. The subsoil swells when wet and shrinks when dry, which is a problem for building site development. The soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the slow or very slow permeability. Buildings without basements are better suited to this soil than those with basements. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Poured reinforced concrete walls stiffened with pilasters reduce problems caused by wetness and the shrinking and swelling of clays. Building sites and septic tank absorption fields should be graded and landscaped to divert surface drainage from footings and leach lines. The use of this soil for local roads and streets is severely limited by low strength and the shrinking and swelling of the soil. Drainage and a suitable base material should be used to lessen these limitations. Wetness also limits recreational uses of this soil.

This soil is in capability subclass IIIw and woodland suitability group 3c.

FtB—Fulton silty clay loam, 2 to 6 percent slopes. This gently sloping, deep, somewhat poorly drained soil is on the lake plains. It is in elongated strips adjacent to drainageways and on convex, low rises and knolls. Most individual areas range from 2 to 10 acres in size.

Typically, this soil has a surface layer of dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 17 inches thick. The upper part is yellowish brown, mottled, very firm silty clay. The lower part is dark yellowish brown, mottled, very firm silty clay. The substratum to a depth of about 60 inches is dark yellowish brown and dark grayish brown, mottled silty clay and thin strata of silty clay loam. In some areas the surface layer contains more sand than is typical.

Included with this soil in mapping are small areas of Latty soils, which are in narrow drainageways and low spots. Also included are small areas of Del Rey soils at the crest of knolls and Kibbie soils at the base of slopes. These soils have less clay in the subsoil and Kibbie soils have a darker colored surface layer than this Fulton soil. Small areas of a soil that is less sloping are also included. Included soils make up about 15 percent of this map unit.

Runoff is medium on this Fulton soil. Permeability is slow or very slow. This soil has a deep root zone and moderate available water capacity. Reaction in the subsoil is medium acid to mildly alkaline. This soil has a seasonal high water table that is near the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the principal crops. Soil erosion is the main management concern. Wetness is also a limitation to cultivation. Subsurface drainage is commonly used to lower the water table. Conservation tillage that leaves crop residue on the surface, winter cover crops, returning crop residue to the plow layer, and grassed waterways help prevent excessive soil erosion. The surface layer of this soil crusts after heavy rains, which slows plant emergence and slows air and water movement into the soil. Controlled grazing should be used when the soil is wet to reduce soil compaction.

This soil is suited to growing trees. Species selected for planting should be tolerant of some wetness. Improving woodland for timber production requires exclusion of livestock and removal of undesirable species and poorly formed trees. Seedling mortality and windthrow hazard are the main management concerns. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table and high shrinking and swelling. The subsoil swells when wet and shrinks when dry. This is a problem for building site development. Backfilling around foundations with pervious material, such as sand and gravel, reduces this problem. The soil is poorly suited to septic tank absorption fields because of the seasonal high water table and the slow or very slow permeability. Buildings without basements are better suited to this soil than those with basements. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Building sites and septic tank absorption fields should be graded and landscaped to divert surface water from footings and leach lines. Building sites bare of vegetation are subject to erosion. Grass seeding should be completed as soon as possible to reduce erosion. The water table can be lowered by subsurface drains around building sites and septic tank absorption fields. Poured reinforced concrete walls stiffened with pilasters help reduce problems caused by wetness and the shrinking and swelling of clay. The use of this soil for local roads and streets is severely limited by low strength and the shrinking and swelling of the soil. Drainage and a suitable base material should be used to lessen these limitations. Wetness limits recreational uses of the soil.

This soil is in capability subclass IIIe and woodland suitability group 3c.

GaB—Galen loamy fine sand, 1 to 6 percent slopes. This gently sloping, moderately well drained soil is on beach ridges, sand dunes, and moraines. It is mostly in oval areas on knolls and in long, broad areas on ridges. Most individual areas range from 2 to 20 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 10 inches thick. The subsoil is about 48 inches thick. The upper part is light yellowish brown, very friable loamy fine sand. The middle part is dark yellowish brown, loose loamy fine sand intermixed with dark brown, friable fine sandy loam. The lower part is dark brown, friable and loose fine sandy loam and loamy fine sand. The substratum to a depth of about 68 inches is yellowish brown, loose fine sand. In some areas the light yellowish brown upper part of the subsoil is at the surface.

Included with this soil in mapping are small areas of the somewhat poorly drained Tedrow soils. Also included are the very poorly drained Granby and Gilford soils, which are in low wet spots and along drainageways. These included soils make up about 15 percent of this map unit.

Runoff is slow on this Galen soil. Permeability in this soil is moderate or moderately rapid, and available water capacity is moderate. The subsoil is medium acid to neutral. This soil has a seasonal high water table that is within the subsoil during extended wet periods. The organic matter content in the surface layer is moderate.

Most areas of this soil are used for farming. The soil is well suited to crops and pasture. Soil erosion is the main management concern, but droughtiness and a seasonal high water table are also limitations. Wind erosion is a problem. It usually occurs after this soil is cultivated and before the new crop is large enough or dense enough to protect the surface soil. Returning crop residue to the plow layer or the regular addition of other organic material helps reduce wind erosion and delays drying of the surface soil. Winter cover crops and conservation tillage that leaves crop residue on the surface also help prevent excessive soil loss. Pasturing is limited by droughtiness. Controlled grazing should be used to protect the quality of plant cover.

This soil is suited to trees. Species selected for planting should be tolerant of some droughtiness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings and septic tank absorption fields, but it is limited for these uses by a seasonal high water table. Buildings without basements are better suited to this soil than those with basements. The walls of shallow excavations tend to slump, especially when the soil is wet. When the soil is bare of vegetation during construction, it is subject to soil blowing. Land shaping and grass seeding should be completed as soon as possible to reduce soil loss. If this soil is used for septic tank absorption fields, the water table can be lowered by subsurface drains. Local streets and roads are moderately affected by frost action and wetness, which can be reduced by installing artificial drainage and using a suitable base material. Establishing and maintaining grass for lawns may be difficult because of droughtiness during the dry months. Wetness and slope moderately limit use for playgrounds, and wetness moderately limits other recreational developments.

This soil is in capability subclass IIe and woodland suitability group 2o.

Gf—Gilford fine sandy loam. This nearly level, very poorly drained soil is on outwash plains, beach ridges, and deltas. It is in irregularly shaped areas on broad flats and in long, narrow depressional areas. Slope is 0 to 2 percent. This soil receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 4 to 60 acres in size.

Typically, the surface layer is a black, friable fine sandy loam about 11 inches thick. The subsoil is about 20 inches thick. The upper part is dark gray, mottled, friable fine sandy loam, and the lower part is grayish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is grayish brown, mottled, loose loamy sand. In some areas the surface layer is loamy sand.

Included with this soil in mapping are small areas of somewhat poorly drained Tedrow soils. They are in oval areas on rises or in narrow areas on ridges. Also included are areas of Granby soils, which contain more sand than the Gilford soil. Some narrow strips of Millgrove soils, which contain more clay, are along drainageways. Included soils make up about 15 percent of this unit.

Permeability is moderately rapid in this Gilford soil. In drained areas, the root zone is deep and available water capacity is moderate. The subsoil is slightly acid or neutral. Runoff is very slow, or the soil is ponded. This soil has a seasonal high water table that is at the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for farming. Drainage is the major management problem for farming. Subsurface drainage is commonly used to lower the water table where outlets are available. Local, frequent ponding after heavy rains may reduce crop productivity. When this soil dries out and is bare of vegetative cover, it is subject to wind erosion. Returning crop residue to the plow layer helps to maintain the organic matter content in the surface layer. This soil is suited to a variety of pasture grasses. Grazing should be restricted when the soil is wet to avoid reduction of the plant population and compaction of the surface.

This soil has limited suitability for growing trees. Species selected for planting should be tolerant of wetness. During wet seasons, use of equipment for harvesting trees is limited.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of a seasonal high water table and local ponding. Buildings without basements are better suited to this soil than those with basements. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. The walls of shallow excavations tend to slump, especially when wet. Septic tank absorption fields are further affected by the poor filtering capacity of the sandy materials and the possibility of polluting nearby ground water. Damage to local streets and roads from frost action and ponding can be reduced by installing artificial drainage and using a suitable base material. Seasonal ponding and wetness also limit recreational uses of this soil.

This soil is in capability subclass IIw and woodland suitability group 4w.

GnB2—Glynwood loam, 2 to 6 percent slopes, eroded. This gently sloping, moderately well drained soil is on till plains and moraines. It is on low ridges and in elongated strips on side slopes adjacent to drainageways. Most individual areas range from 2 to 20 acres in size.

Typically, this soil has a surface layer of dark brown, friable loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is dark yellowish brown, mottled, firm clay, and the lower part is brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam. In some areas the soil is shallower to the substratum. In other areas it is severely eroded and has more clay in the surface layer.

Included with this soil in mapping are somewhat poorly drained Blount soils, which are in less sloping areas than the Glynwood soil, and Rawson soils, which have a sandier subsoil. These inclusions make up about 15 percent of this map unit.

Runoff is medium on this Glynwood soil. Permeability is slow. This soil has a moderately deep root zone, and moderate available water capacity. The subsoil is strongly acid to neutral in the upper part and medium acid to moderately alkaline in the lower part. This soil has a seasonal high water table at a depth of 2 to 3.5 feet during wet seasons. The organic matter content is moderately low.

Most areas of this soil are used for crops, but some areas are used for pasture and as woodland. The soil is suited to corn, soybeans, and wheat and to hay and pasture. Erosion control is the main management concern. Winter cover crops, conservation tillage that leaves crop residue on the surface, and grassed waterways help to control erosion. Returning crop residue and other organic material to the plow layer helps control erosion as well as improve fertility and tilth of the soil. Natural drainage is generally adequate, but random tile lines are beneficial in draining wet spots and seeps. Controlled grazing should be used to reduce soil compaction and avoid damage to plants when the soil is wet.

This soil is suited to growing trees. Species planted should tolerate some droughtiness. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Improving woodland for timber production requires the exclusion of livestock and the removal of undesirable species and poorly formed trees. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited to sites for buildings, but it is limited by a seasonal high water table. It is moderately well suited to septic tank absorption fields because of a seasonal high water table and slow permeability. Building sites should be landscaped and graded to provide good surface drainage away from the building. The water table can be lowered by subsurface drains. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Damage to local roads and streets from frost action and low soil strength can be reduced by providing artificial drainage and a suitable base material. Wetness, slow permeability, and slope limit most recreational uses of the soil.

The soil is in capability subclass IIIe and woodland suitability group 2c.

GnC2—Glynwood loam, 6 to 12 percent slopes, eroded. This moderately sloping, moderately well drained soil is on till plains and moraines. It is on side slopes of ridges and on breaks of slopes along drainageways. Most individual areas range from 2 to 30 acres in size.

Typically, this soil has a surface layer of dark grayish brown, friable loam about 7 inches thick. The subsoil is about 17 inches thick and is dark yellowish brown, mottled, firm clay and clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam. In some areas the soil is shallower to the substratum.

Included with this soil in mapping are small areas of soils that are severely eroded. Also included are areas where soils are sloping or more sloping. Areas of the very poorly drained Pewamo soils are in narrow drainageways. Included soils make up about 15 percent of this unit.

Runoff is rapid on the Glynwood soils. Permeability is slow. The organic matter content is moderately low. The root zone is moderately deep, and the available water capacity is moderate. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to moderately alkaline in the lower part. The water table is in the subsoil during extended wet periods.

In most areas this soil is used for crops. The soil is suited to corn, soybeans, and small grains. It is well suited to grasses and legumes for hay and pasture. The erosion hazard is severe in cultivated areas, especially if the soil is fall plowed. Measures to increase infiltration, such as no-till or conservation tillage that leaves crop residue on the surface, reduce soil loss by erosion. Establishing grassed waterways where runoff is concentrated helps prevent the formation of gullies. Grazing when the soil is wet causes surface compaction, excessive runoff, and reduced yields. Proper stocking rates, pasture rotation, and restricted grazing when the soil is wet help keep the pasture and the soil in good condition.

This soil is suited to trees. Trees selected for planting should be tolerant of some droughtiness. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Logging roads and skid trails are best constructed on the contour where possible. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited to sites for buildings but is limited by a seasonal high water table. It is moderately well suited to septic tank absorption fields because of a seasonal high water table and slow permeability. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Rainwater from eavespouts should also be directed away from the building site. The water table can be lowered by subsurface drainage. Septic tank absorption fields should be installed on the contour to prevent surfacing of effluent. Local roads and streets may be damaged by frost action and low strength of the soil. Drainage and a suitable base material should be used to help overcome these problems. Wetness, slow permeability, and slope moderately limit most recreational uses of this soil.

This soil is in capability subclass IIIe and woodland suitability group 2c.

GnD2—Glynwood loam, 12 to 18 percent slopes, eroded. This moderately steep, moderately well drained soil is on till plains and moraines. It is on narrow breaks of slopes adjacent to major drainageways and on side slopes of morainic ridges. Most individual areas range from 3 to 15 acres.

Typically, this soil has a surface layer of dark grayish brown, friable loam about 6 inches thick. The subsoil is about 21 inches thick. It is dark yellowish brown and brown, mottled, firm clay and clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam.

Included with this soil in mapping are small areas of a soil that is severely eroded. Also included are areas where the soil is less sloping or more sloping. The somewhat poorly drained Blount soils are along narrow drainageways. Included soils make up about 15 percent of this map unit.

Runoff is very rapid on the Glynwood soil. Permeability is slow. This soil has a moderately deep root zone and a moderate available water capacity. Reaction in the subsoil is strongly acid to neutral in the upper part and medium acid to moderately alkaline in the lower part. This soil has a seasonal high water table at a depth of 2 to 3.5 feet during wet seasons. The organic matter content is moderately low.

Most areas of this soil are used for crops and pasture. This soil is suited to small grains and to hay and pasture. Occasionally, it is used for row crops. The erosion hazard is severe in cultivated areas, especially if the soil is fall plowed. Soil loss may be excessive if the surface is bare of vegetative cover. No-till or conservation tillage that leaves crop residue on the surface reduces soil loss by erosion. Establishing grassed waterways where runoff is concentrated helps prevent formation of gullies. Using heavy machinery or grazing when the soil is wet causes surface compaction, excess runoff, and reduced yields. Proper stocking rates, pasture rotation, and restricted grazing when the soil is wet help keep the pasture and the soil in good condition.

This soil is suited to trees. Trees selected for planting should be tolerant of droughty conditions. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Logging roads and skid trails should be constructed on the contour wherever possible. Plant competition can be reduce by spraying, mowing, or disking.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of seasonal wetness, slow permeability, and slope. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Rainwater from eavespouts should also be directed away from the building site. Septic tank absorption fields should be installed on the contour to prevent surfacing of effluent. Local roads and streets may be damaged by frost action and low strength of the soil. Drainage and suitable base material should be used. Slope limits recreational uses of the soil.

The soil is in capability subclass IVe and woodland suitability group 2c.

GoC3—Glynwood clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping, moderately well drained soil is on till plains and moraines. It is on side slopes of ridges and on breaks of slopes along drainageways. Most individual areas range from 2 to 10 acres in size.

Typically, this soil has a surface layer of dark brown, firm clay loam about 4 inches thick. The subsoil is about 11 inches thick. It is dark yellowish brown, mottled, firm clay and clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam. In some areas the substratum is at the surface.

Included with this soil in mapping are small areas of a soil that is slightly eroded. Also included are areas where soils are less sloping or more sloping. Included soils make up about 15 percent of this map unit.

Runoff is rapid on this Glynwood soil. Permeability is slow. The organic matter content is low. The root zone is moderately deep in some places and shallow in others. The available water capacity is low. Reaction in the subsoil is strongly acid to moderately alkaline. A seasonal high water table is at a depth of 2 to 3.5 feet during extended wet periods.

In most areas this soil is used for crops or pasture. A few areas are in replanted woods. This soil is suited to small grains and pasture. The hazard of erosion is severe in cultivated areas. When cultivated, this soil erodes easily and gullies form. Establishing grassed waterways where runoff is concentrated helps prevent gully erosion. Water from above should be diverted from these short slopes. Winter cover crops and no-till or conservation tillage that leaves crop residue on the surface help control erosion. When the soil is wet, controlled grazing should be used to reduce soil compaction and avoid damage to plants.

This soil is suited to trees. Trees selected for planting should tolerate droughtiness. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings but is limited by a seasonal high water table. It is also moderately well suited to septic tank absorption fields because of the seasonal high water table and slow permeability. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Rainwater from eavespouts should also be diverted from the building site. The water table can be lowered by subsurface drainage. Building sites should be seeded as soon as possible to reduce erosion. Lawns are hard to establish, and grasses tolerant of alkaline soils should be used. Local roads and streets may be damaged by frost action and the low strength of the soil. Drainage and suitable base material should be used to help overcome these problems. Wetness, slow permeability, and slope moderately limit this soil for some recreational uses.

This soil is in capability subclass IVe and woodland suitability group 2c.

Gr—Granby loamy fine sand. This nearly level, very poorly drained soil is on outwash plains and lake plains. It is in irregularly shaped areas on broad flats and in long, narrow depressional areas. It receives runoff from adjacent higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most individual areas range from 2 to 140 acres in size.

Typically, the surface layer is black, very friable loamy fine sand about 10 inches thick. The subsurface layer is about 8 inches thick. It is very dark grayish brown, very friable loamy fine sand. The subsoil is about 18 inches thick. It is gray and dark gray, mottled, very friable and loose fine sand. The substratum to a depth of about 60 inches is grayish brown and olive brown, mottled, loose fine sand. In some areas the soil has an organic layer up to 5 inches thick.

Included with this soil in mapping are small oval areas of the somewhat poorly drained Tedrow soils on slight rises. Also included are areas of Gilford soils, which contain more clay in the subsoil than this Granby soil. Included soils make up about 15 percent of this map unit.

Permeability is rapid on this Granby soil. In drained areas the soil has a deep root zone and low available water capacity. Reaction in the subsoil is medium acid to mildly alkaline. Runoff is very slow, or the soil is ponded. This soil has a seasonal high water table that is at the surface during extended wet periods. The moisture supplying capacity is commonly adequate even during dry weather. The organic matter content is high.

Most areas of this soil are used for farming or as woodland. The soil is suited to row crops and to hay and pasture (fig. 7). Drainage is the major management concern in farming. Subsurface drainage is commonly used to lower the water table where adequate outlets are available. Local, frequent ponding may reduce crop production. When this soil dries out and is bare of vegetative cover, it is subject to wind erosion. Crop residue left on the surface aids in controlling erosion. This soil is suited to a variety of pasture grasses, but for best results a water-tolerant variety should be used.

Figure 7.—Granby loamy fine sand is suited to hay.

Grazing should be restricted when the soil is wet to avoid reduction of the plant population.

Many areas of this soil are in woodland. This soil has limited suitability for growing trees. Use of equipment is limited by seasonal wetness and ponding. Trees selected for planting should be tolerant of wetness.

This soil is poorly suited as sites for buildings because of a seasonal high water table and local ponding. It is poorly suited to septic tank absorption fields because of local ponding, seasonal wetness, and poor filtering qualities of the sandy material. The water table can be lowered by drainage where adequate outlets are available. The walls of shallow excavations tend to slump. Local roads and streets may be damaged by ponding and frost action. Drainage and suitable base material should be used to lessen these problems.

Wetness and ponding are limiting for many recreational uses.

This soil is in capability subclass IIIw and woodland suitability group 4w.

HkA—Haskins loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on outwash plains, terraces, and beach ridges. It is in oval areas on knolls and in moderately broad areas on flats. On beach ridges it commonly is in elongated strips. Most individual areas range from 2 to 15 acres in size.

Typically, this soil has a surface layer of dark grayish brown, friable loam about 9 inches thick. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, mottled, friable sandy clay loam, and the lower part is grayish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, very firm clay loam. In some areas this soil has more sand in the surface layer and the upper part of the subsoil.

Included with this soil in mapping are narrow strips of Mermill soils in drainageways and depressions. Also included are small areas of Digby soils, which have less clay in the substratum than the Haskins soil, and Nappanee soils, which have more clay in the subsoil. Included soils make up about 15 percent of this map unit.

Permeability is moderate in the upper part of this Haskins soil and slow or very slow in the substratum. In drained areas the soil has a deep root zone and moderate available water capacity. Reaction in the subsoil is strongly acid to mildly alkaline. Runoff is slow. The soil has a seasonal high water table that is near the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for farming. The soil is well suited to row crops and pasture. Wetness is a moderate limitation. Subsurface drainage systems are commonly used to lower the water table where adequate outlets are available. On more sloping soils, erosion is also a hazard. Livestock should be restricted from grazing during wet weather to prevent excessive soil compaction and damage to plants. Planting cover crops and leaving crop residue on the surface help control erosion, improve tilth, and increase water infiltration.

This soil is well suited to trees. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonally high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table and slow or very slow permeability. Building sites should be landscaped and graded away from the foundation to provide good surface drainage. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. The water table can be lowered by subsurface drainage where adequate outlets are available. Damage to local roads and streets from frost action can be reduced by providing artificial drainage and a suitable base material. Wetness and slow or very slow permeability also limit recreational uses.

This soil is in capability subclass IIw and woodland suitability group 2o.

Ho—Hoytville clay loam. This nearly level, very poorly drained soil is on lake plains. It is in broad areas on flats and in long narrow units along drainageways. Slope is 0 to 2 percent. This soil receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 8 inches thick. The subsoil is about 30 inches thick. It is grayish brown, mottled, firm clay and clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, firm clay loam. In some areas the soil has carbonates within 20 inches of the surface. In others the surface layer is sandier or has more clay.

Included with this soil in mapping are small areas of somewhat poorly drained Nappanee and Haskins soils on low knolls. Also included are small areas of sandier Mermill soils on low knolls and ridges. These included soils make up about 15 percent of most mapped areas.

Runoff is very slow, or this Hoytville soil is ponded. Permeability is moderately slow in the subsoil and slow in the substratum. In drained areas the soil has a deep root zone and moderate available water capacity. The subsoil is slightly acid to mildly alkaline. This soil has a seasonal high water table that is at the surface during extended wet periods. The organic matter content is high.

Most areas of this soil are used for crops. Corn, soybeans, and wheat are the principal crops. Some areas are used for specialty crops. Tomatoes are the major specialty crop. Moderate wetness is a limitation. Unless adequate drainage is provided, seedling stands and yields are reduced. Subsurface drains are commonly used to remove excess water from the root zone. Drainage improves plant growth and makes cultivation more timely by lowering the water table to allow the soil to dry out earlier. The use of cover crops and crop residue improves tilth and increases water infiltration. If this soil is used for pasture, grazing should be controlled to reduce compaction when the soil is wet.

This soil is suited to trees and to habitat for wetland wildlife. During wet seasons, use of tree harvesting equipment is limited. Wetness also increases tree seedling mortality and windthrow hazard. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Tree species that can tolerate wetness should be selected for new plantings. Improving woodland for timber production requires excluding livestock and removing undesirable species and poorly formed trees. This soil is well suited to shallow water impoundments and wetland plants.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of a seasonal high water table, slow permeability, and local surface ponding. If used for homesites, this soil is better suited to houses without basements than to those with basements. Building sites should be landscaped and graded to provide good surface drainage away from foundations. Rainwater from eavespouts should be diverted from the house. The subsoil and substratum swell when wet and shrink when dry, which is a hazard in the construction of homes. Poured reinforced concrete walls stiffened with pilasters reduce problems caused by wetness and shrinking and swelling of clays. Local roads and streets may be damaged by ponding water, low soil strength, and frost action. Drainage and suitable base material should be used to lessen these problems. Wetness or ponding limits most recreational uses of this soil.

This soil is in capability subclass IIw and woodland suitability group 3w.

KfA—Kibbie loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on outwash plains and deltas. It is in long narrow areas on low ridges and in oval areas on convex, low knolls. Most individual areas range from 2 to 20 acres in size.

Typically, this soil has a surface layer of very dark grayish brown, friable loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, mottled, friable loam. The lower part is brown, mottled, friable silt loam. The substratum to a depth of about 60 inches is brown, friable, stratified silt loam, fine sand, and silty clay loam. In some areas the surface layer and upper part of the subsoil are silt loam.

Included with this soil in mapping are small areas of very poorly drained Colwood and Lenawee soils, which are in drainageways and low wet spots. Also included are areas of Bixler soils that contain more sand in the surface layer and upper part of the subsoil. Included soils make up about 15 percent of this map unit.

Runoff is slow from the Kibbie soil. Permeability is moderate. This soil has a deep root zone and high available water capacity. The subsoil is medium acid to mildly alkaline. This soil has a seasonal high water table that is near the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for farming. The soil is well suited to corn, soybeans, and small grains and to hay and pasture. Drainage is the main management concern. Wetness delays planting and limits the choice of crops. Subsurface drainage is commonly used to lower the water table. Seedling emergence may be hindered by surface crusting. Use of cover crops and keeping crop residue on the surface help control erosion, improve tilth, and increase water infiltration. Controlled grazing should be used to reduce soil compaction and protect plant populations when the soil is wet.

This soil is well suited to growing trees. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings and poorly suited to septic tank absorption fields because it has a seasonal high water table. Buildings without basements are better suited to this soil than those with basements. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. The walls of shallow excavations tend to slump, especially when wet. The water table can be lowered by subsurface drainage where adequate outlets are available. An unstable substratum is an added problem for homes with basements. Damage to local roads and streets from frost action can be reduced by providing artificial drainage and by using a suitable base material. Wetness also limits recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2o.

La—Lamson fine sandy loam. This nearly level, deep, very poorly drained soil is on lake plains. It is in broad areas on flats and in long, narrow, depressional areas. Slope is 0 to 2 percent. This soil receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 4 to 50 acres in size.

Typically, the surface layer is black, friable fine sandy loam about 9 inches thick. The subsoil is about 21 inches thick. It is brown and dark grayish brown, mottled, friable fine sandy loam. The substratum to a depth of about 60 inches is gray, grayish brown, and dark grayish brown, stratified very fine sand, silt loam, and silt. It is friable. In some areas the surface layer is thicker. In others the surface layer and subsoil contain more sand.

Included with this soil in mapping are small, oval or elongated areas of somewhat poorly drained Bixler and Kibbie soils on rises. Also included are areas of Colwood and Granby soils, which have a thicker dark surface layer and are in depressions and along drainageways. These included soils make up about 15 percent of the map unit.

Runoff is very slow on this Lamson soil, and ponding is common. Permeability is moderate. In drained areas this soil has a deep root zone. The available water capacity is moderate. Reaction in the subsoil is medium acid to neutral. This soil has a seasonal high water table that is at the surface during extended wet periods. The organic matter content is high.

Most areas of this soil are used for farming. The very poor natural drainage is the main limitation for farming. If drained, this soil is suited to corn, soybeans, wheat, and oats and to hay and pasture. Specialty crops are tomatoes and potatoes. Subsurface drainage systems are commonly used to lower the water table where adequate outlets are available. Surface ditches are another important part of this drainage system. Most areas have been drained to improve plant growth and to make fieldwork easier. This soil is subject to wind erosion when it is dry and cultivated. Crop residue left on the surface helps reduce wind erosion. Livestock should be restricted from grazing during wet periods to prevent excessive damage to plants.

This soil is suited to trees and to habitat for wetland wildlife. During wet seasons, use of tree harvesting equipment is limited. Tree species that can tolerate wetness should be selected for new plantings. Improving woodland for timber production requires exclusion of livestock and removal of undesirable species and poorly formed trees. Soil wetness increases tree seedling mortality and windthrow hazard. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. This soil is suited to wetland plants. Shallow water impoundments are subject to soil slippage and a fluctuating water table.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of the seasonal high water table and local surface ponding. This soil is better suited to houses without basements than to those with basements. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Rainwater from eavespouts should be diverted from the house. The walls of shallow excavations tend to slump. Local roads and streets may be damaged by ponding water and frost action. Drainage and suitable base material should be used to lessen these problems. Seasonal wetness and ponding are limitations for most recreational uses of this soil.

This soil is in capability subclass IIIw and woodland suitability group 4w.

Lc—Latty silty clay. This nearly level, deep, very poorly drained soil is on lake plains. It is in broad areas on flats and in long depressional areas. Slope is 0 to 2 percent. This soil receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 5 to 90 acres in size.

Typically, the surface layer is dark gray, firm silty clay about 9 inches thick. The subsoil is about 43 inches thick. It is dark gray and gray, mottled, firm clay. The substratum to a depth of about 60 inches is gray, mottled, firm clay. In some areas calcareous glacial till is below a depth of 40 inches. In others the surface layer is darker.

Included with this soil in mapping are small areas of somewhat poorly drained Nappanee and Haskins soils, which are in small oval or elongated areas on rises. Also included are small areas of Lenawee and Colwood soils, which have a darker surface layer. These two soils are in depressions and along drainageways. These included soils make up about 15 percent of most map areas.

Runoff is very slow, or this Latty soil is ponded. Permeability is slow in the subsoil and very slow in the substratum. In drained areas, the soil has a deep root zone and moderate available water capacity. Reaction in the subsoil is slightly acid to moderately alkaline. This soil has a seasonal high water table that is at the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for crops. A few areas are in woodland. The very poor natural drainage is the main limitation for farming. If drained, the soil is suited to corn, soybeans, wheat, and pasture. Specialty crops, such as tomatoes and sugar beets, can be grown on drained soils. Stands of wheat are poor in some years on soils that have been inadequately drained. A combination of subsurface and surface drains is commonly used to improve drainage. Using cover crops and leaving crop residue on the surface improve tilth and increase water infiltration. Tilling within a limited range of moisture content is important because this soil becomes compacted and cloddy if worked when wet and sticky. Controlled grazing should be used to reduce soil compaction when the soil is soft and sticky because of wetness.

This soil is suited to trees and to habitat for wetland wildlife. Wetness limits the use of harvesting equipment. Tree species that can tolerate wetness and the clayey surface layer and subsoil should be selected for new plantings. Seedling mortality, windthrow hazard, and plant competition are other management concerns. Plant competition can be reduced by spraying, mowing, or disking. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. This soil is well suited to shallow water impoundments and wetland plants.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of the seasonal high water table, local surface ponding, slow and very slow permeability, and high shrink-swell potential. If used for housing, this soil is better suited to houses without basements than to those with basements. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Rainwater from eavespouts should be drained away from the house. Placing drains at the base of footings helps prevent wet basements. Basement wetness and shrink-swell damage can be reduced by poured, reinforced concrete walls that are stiffened with pilasters and by installing perimeter drains a few feet away from the house. Local roads and streets may be damaged by ponding water, low soil strength, and shrinking and swelling of the clay. Surface and subsurface drainage and a suitable base material should be used to lessen these problems. Ponding and the clayey surface layer limit most recreational uses of this soil.

This soil is in capability subclass IIIw and woodland suitability group 3w.

Lf—Lenawee silty clay loam. This nearly level, deep, very poorly drained soil is on lake plains. It is in broad areas on flats and in long, narrow, depressional areas. Slope is 0 to 2 percent. Most individual areas range from 5 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 26 inches thick. The upper part is grayish brown, mottled, firm silty clay. The lower part is gray, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is gray and dark yellowish brown silty clay loam. In some places the surface layer is darker.

Included in mapping are small areas of somewhat poorly drained Del Rey and Kibbie soils on small knolls. Also included are areas of Colwood soils, which have less clay and more silt and fine sand in the subsoil than this Lenawee soil, and Latty soils, which have more clay throughout. These included soils make up about 15 percent of this map unit.

Runoff is very slow, or this Lenawee soil is ponded. Permeability is moderately slow. The root zone is deep, and the available water capacity is high. Reaction in the subsoil is medium acid to mildly alkaline. This soil has a seasonal high water table that is at or near the surface during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for farming. This soil is well suited to row crops and small grains and to pasture. Drainage is the main management concern. Subsurface drainage is commonly used to lower the water table where adequate outlets are available (fig. 8). The surface layer has a tendency to crust after heavy rains. This slows seedling emergence. Grazing should be controlled when the soil is wet to reduce compaction.

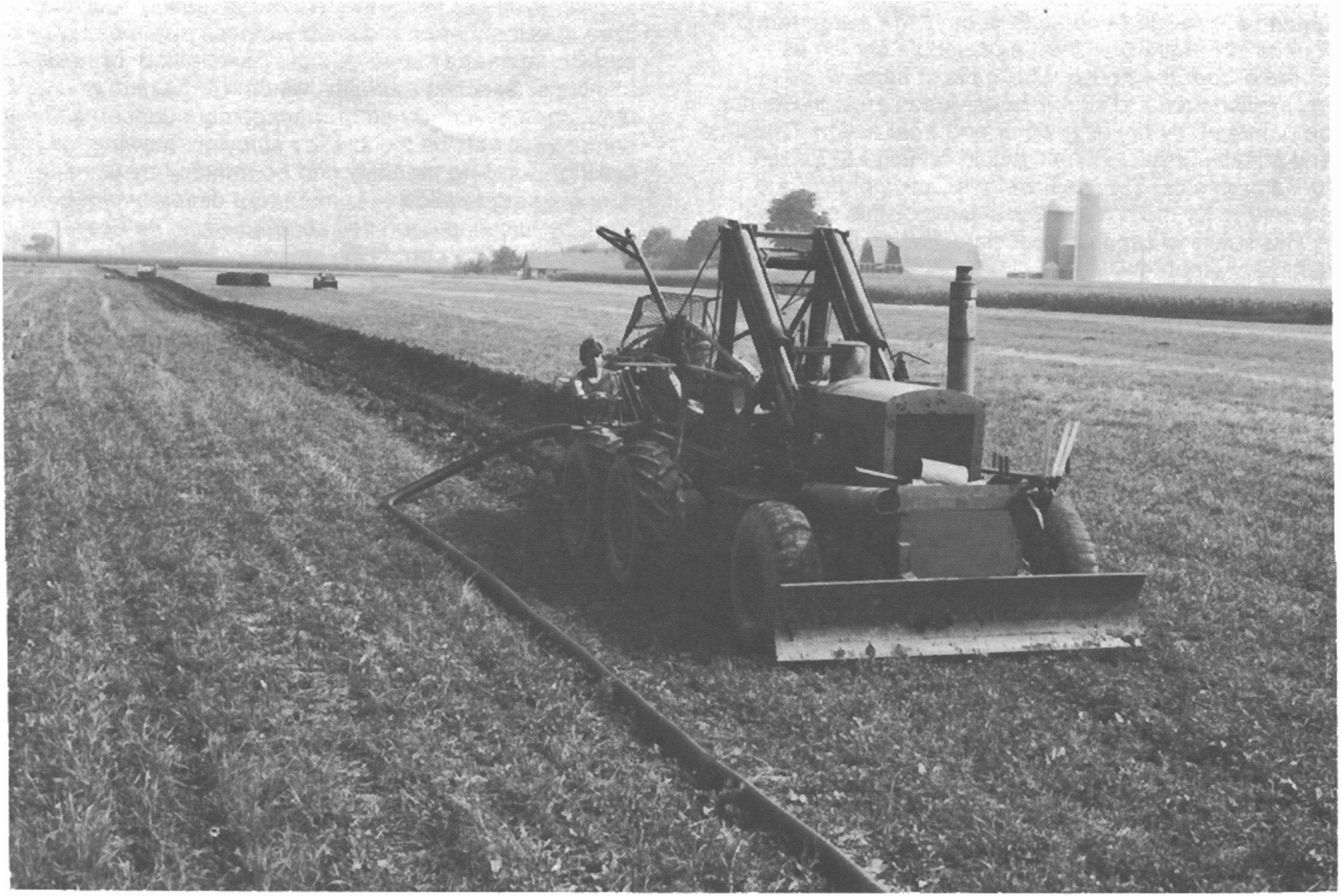


Figure 8.—Installing subsurface drains in Lenawee silty clay loam. Removing excess water is the main management concern on this soil.

This soil is suited to trees. Species being planted should be tolerant of wetness. During wet seasons, use of tree harvesting equipment is limited. Seedling mortality, windthrow hazard, and plant competition are other management concerns. Plant competition can be limited by mowing, spraying, or disking. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind tunnels or wind pockets.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of wetness. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. The water table can be lowered by subsurface drainage where adequate outlets are available. This can be determined by onsite investigations. Local roads and streets may be damaged by frost action, low soil strength, and wetness. Drainage and suitable base material should be used to lessen these problems. Wetness limits the recreational use of this soil.

This soil is in capability subclass IIw and woodland suitability group 2w.

Mf—Mermill loam. This nearly level, very poorly drained soil is on outwash plains, terraces, and beach ridges. It is in broad areas on flats and in narrow elongated areas along drainageways. Slope is 0 to 2 percent. This soil receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 2 to 30 acres in size.

Typically, the surface layer is very dark gray, friable loam about 9 inches thick. The subsoil is about 38 inches thick. It is grayish brown, mottled, firm sandy clay loam in the upper part and gray, mottled, firm clay in the lower part. The substratum to a depth of about 60 inches is brown, mottled, very firm clay loam. In some areas the upper part of the subsoil is sandy loam.

Included with this soil in mapping are somewhat poorly drained Haskins soils on small rises. Also included are small areas of Millgrove soils that have clayey material at a depth of more than 40 inches. These included soils make up about 15 percent of this map unit.

Runoff is very slow, or this Mermill soil is ponded. Permeability is moderate in the upper part of the soil and slow or 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. Reaction in the subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The water table is at the surface during extended wet periods.

In most areas this soil is used for crops. It is well suited to crops and pasture. The main crops are corn, soybeans, and small grains. Truck crops and specialty crops are grown in some areas where the drainage has been improved. If this soil is used for crops or pasture, drainage needs to be improved. Subsurface drainage can be used to lower the water table. The use of cover crops and returning crop residue to the plow layer help maintain the organic matter content. If this soil is used as pasture, grazing should be restricted during wet periods 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, windthrow hazard, and plant competition are other management concerns. Plant competition can be limited by mowing, spraying, or disking. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels.

This soil is poorly suited as sites for buildings and septic tank absorption fields by the seasonal high water table, ponding, and slow or very slow permeability in the lower part. Local roads and streets are subject to damage caused by frost action and ponding. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used. Wetness and the slow or very slow permeability in the lower part are limitations to many recreational uses of the soil. Some areas are good sites for ponds; however, special construction practices are needed to reduce seepage in the upper part of the soil (fig. 9).

This soil is in capability subclass IIw and woodland suitability group 2w.

Mo—Millgrove loam. This nearly level, very poorly drained soil is on outwash plains, terraces, and beach ridges. It is in broad areas on flats and in narrow elongated areas along drainageways. Slope is 0 to 2 percent. This soil receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 2 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is about 24 inches thick. It is gray and dark gray firm clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, friable gravelly sandy loam. In some areas the surface layer is fine sandy loam or clay loam.

Included with this soil in mapping are somewhat poorly drained Digby and Brady soils on slight rises. Also included are small areas of Mermill soils on which the clayey material is less than 40 inches from the surface. These included soils make up about 15 percent of this unit.

Figure 9.—This pond, used for recreation and fire protection, is on Mermill loam. Special construction practices were needed to reduce seepage in the upper part of this soil.

Runoff is very slow, or this Millgrove soil is ponded. Permeability is moderate in the surface layer and subsoil and moderately 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 high. Reaction in the subsoil is slightly acid in the upper part and neutral and mildly alkaline in the lower part. The water table is at the surface during extended wet periods.

In most areas this soil is used for crops. It is well suited to crops and pasture. The main crops are corn, soybeans, and small grains. Truck crops and specialty crops are grown in areas where the drainage has been improved. Drainage is the main management concern. Subsurface drainage can be used to lower the water table. Using cover crops and returning crop residue to the plow layer help 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. Plant competition, seedling mortality, and windthrow hazard are other management concerns. Plant competition can be reduced by spraying, mowing, or disking. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels.

This soil is poorly suited to building site development and septic tank absorption fields by the seasonal high water table and the hazard of ponding. Local roads and streets are subject to damage caused by wetness, frost action, 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 recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2w.

NnA—Nappanee loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is in broad areas on lake plains. Individual areas are irregularly shaped on knolls or are long and narrow. They range from 2 to 20 acres.

Typically, the surface layer is dark grayish brown friable loam about 6 inches thick. The subsoil extends to a depth of about 26 inches. It is brown, mottled, firm and very firm clay in the upper part and grayish brown, mottled very firm clay in the lower part. The substratum to a depth of about 60 inches is brown, mottled, very 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 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 clay loam to silty clay are also included. These included soils make up about 15 percent of this unit.

Runoff is slow on this Nappanee soil. Permeability is slow. The root zone is deep, and the available water capacity is moderate. The organic matter content is moderate. Reaction in the subsoil is neutral or mildly alkaline. The water table is at a depth of 1 foot and 2 feet during extended wet periods.

This soil is suited to crops and to pasture. Drainage is the main management concern. In most areas this soil is used for crops. Subsurface drainage can be used to lower the water table. Using cover crops and returning crop residue to the plow layer can improve tilth and increase water infiltration. If this soil is used for 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 droughtiness. Improving woodland for timber production requires the exclusion of livestock and the removal of undesirable species and poorly formed trees. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Plant competition can be reduced by spraying, mowing, and disking. Harvesting and management to control plant competition should be limited to the dry parts of the year.

This soil is moderately well suited as sites for buildings but is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because it has a seasonal high water table and slow permeability. Where outlets are available, the water table can be lowered by 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 low strength. If this soil is used for local roads and streets, drainage should be improved and a suitable base material used to lessen these problems. Wetness is a limitation for most recreation uses.

This soil is in capability subclass IIIw and woodland suitability group 3c.

NnB—Nappanee loam, 2 to 6 percent slopes. This gently sloping, deep soil is somewhat poorly drained. It is in broad areas on lake plains. It is in irregularly shaped areas on knolls and in long, narrow areas along drainageways. The individual 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 28 inches. It is dark brown, mottled, firm and very firm clay. The substratum to a depth of about 60 inches is dark brown, mottled, very firm clay.

Included in mapping are small areas of Haskins soils, which have more sand in the upper part of the subsoil than the Nappanee soil. The Haskins soils are on low knolls. Areas of soils that have a surface layer of clay loam to silty clay are also included. These included soils make up about 15 percent of this map unit.

Runoff is medium on this Nappanee soil. Permeability is slow. The root zone is deep, and the available water capacity is moderate. The organic matter content is moderate. Reaction in the subsoil is neutral or mildly alkaline. The water table is at a depth of 1 foot to 2 feet during extended wet periods.

In most areas this soil is used for crops. It is suited to row crops and small grains and to pasture. The hazard of erosion is the main concern of management. Wetness also is a limitation if this soil is used for crops. Conservation tillage that leaves crop residue on the surface, planting winter cover crops, returning crop residue to the plow layer, and grassed waterways help to prevent excessive soil loss caused by erosion. The use of cover crops and crop residue can improve tilth and increase water infiltration. Subsurface drainage can be used to lower the water table. If this soil is used for 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 droughtiness. If this soil is used for timber production, livestock should be excluded from grazing in the woodland and the undesirable species and poorly formed trees should be removed. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Plant competition can be reduced by spraying, mowing, or disking. Harvesting and management to control plant competition should be limited to dry parts of the year.

This soil is moderately well suited to building sites but is limited by the seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table and slow permeability. Where outlets are available, the water table can be lowered by 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 low soil strength. Drainage should be improved and a suitable base material used to lessen these problems. Wetness is a limitation to most recreational uses.

This soil is in capability subclass IIIe and woodland suitability group 3c.

OaB—Oakville fine sand, 0 to 6 percent slopes. This gently sloping, well drained soil is on beach ridges, sand dunes, and moraines. Most individual areas are long and narrow on ridges and oval on knolls. They range from 2 to 10 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sand about 9 inches thick. The subsoil is yellowish brown, loose fine sand about 30 inches thick. The substratum to a depth of about 72 inches is brown loose fine sand. In places the original surface layer has been removed by wind erosion. In some areas the lower part of the subsoil has thin, brown or strong brown, discontinuous bands.

Included with this soil in mapping are small areas of the moderately well drained Ottokee soils and the somewhat poorly drained Tedrow soils, which are in low parts of the landscape. Also included are very poorly drained Granby soils, which are in low wet spots and along drainageways. These included soils make up about 15 percent of this map.

Runoff is slow on this Oakville soil. Permeability is rapid. The soil has a deep root zone and low available water capacity. Reaction in the subsoil is strongly acid to neutral. The organic matter content is low.

Most areas of this soil are used for farming or as woodland. The main management concern is droughtiness. Wind erosion is a hazard after this soil is cultivated and before the new crop is high enough or dense enough to protect the surface of the soil. Returning crop residue to the surface or the regular addition of other organic material to the plow layer helps resist wind erosion and delays drying of the surface soil. Conservation tillage that leaves crop residue on the surface and planting winter cover crops help prevent excessive soil loss. Pasturing is limited by droughtiness. Controlled grazing should be used to protect the quality of plant cover.

This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. New seedlings may need to be irrigated during the driest time of the year to help them become established.

This soil is well suited as sites for buildings. It is moderately well suited to septic tank absorption fields. Ground water may be polluted because of the poor filtering capacity of the sandy material. In shallow excavations for homes with basements, the walls tend to slump, especially when the soil is wet. Construction sites are subject to wind erosion when the soil is dry and bare of vegetative cover. Droughtiness generally makes new lawns hard to establish and maintain. The sandy texture of the surface layer is a limitation for most recreational uses of this soil.

This soil is in capability subclass IVs and woodland suitability group 3s.

OaC—Oakville fine sand, 6 to 12 percent slopes. This moderately sloping, well drained soil is on the side slopes. It is in narrow areas on beach ridges and sand dunes. Most individual areas range from 2 to 10 acres.

Typically, the surface layer is dark grayish brown fine sand about 6 inches thick. The subsoil extends to a depth of about 28 inches. It is brown and yellowish brown, loose fine sand. The substratum to a depth of about 62 inches is brown fine sand.

Included in mapping are small areas of moderately well drained Ottokee soils and somewhat poorly drained Tedrow soils in low positions on the landscape. Also included are areas of Spinks soils that contain bands of loamy sand in the subsoil. The included soils make up about 15 percent of this map unit.

Runoff is medium on this Oakville soil, and permeability is rapid. The root zone is deep, and the available water capacity is low. Reaction in the subsoil is strongly acid to neutral. The organic matter content is low.

In most areas this soil is used for crops. Droughtiness is the main limitation if this soil is used for crops. The steepness of slope and the hazard of wind erosion are also limitations. Because the soil dries out early, moisture in the root zone is usually very limited during the summer. The soil usually is eroded by wind after it is cultivated and before the new crop is large enough or dense enough to protect the surface. Returning crop residue to the plow layer or regularly adding other organic material, conservation tillage which leaves crop residue on the surface, or planting winter cover crops help resist wind erosion and delay drying of the surface soil. If this soil is used as pasture, droughtiness and the loose surface soil are limitations. Overgrazing pasture reduces the plant population.

This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. New seedlings may need to be irrigated during the driest time of the year to help them become established. When this soil is used as woodland, the undesirable species and poorly formed trees should be removed and livestock excluded.

This soil is well suited as sites for buildings. The walls of excavations for homes with basements tend to collapse, especially when the soil is wet. Construction sites are subject to wind erosion when the soil is dry and bare of vegetative cover. Droughtiness generally makes lawn management difficult. The soil is moderately well suited to septic tank absorption fields; however, nearby ground water may be polluted because of the poor filtering capacity of the sandy material. The sandy texture of the surface layer is a limitation for most recreational uses.

This soil is in capability subclass VIs and woodland suitabilty group 3s.

OrB—Oshtemo loamy sand, 0 to 6 percent slopes. This gently sloping, well drained soil is on outwash plains, beach ridges, and moraines. The areas on ridges are long and narrow and those on low knolls are oval. Individual areas range from 2 to 30 acres.

Typically, the surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 7 inches thick. The subsoil extends to a depth of about 46 inches. It is brown, friable sandy loam in the upper part and yellowish brown, very friable loamy sand and thin horizontal bands and nodules of brown and dark reddish brown sandy loam in the lower part. The substratum to a depth of 60 inches is stratified, pale brown and brown sand and gravelly sand. In some areas the surface is very dark grayish brown.

Included in mapping are small areas of sandy Spinks soils and small areas of Boyer soils, which are shallower to the substratum than the Oshtemo soils. These included soils make up about 15 percent of this map unit.

Runoff is slow on the Oshtemo soil. Permeability is moderately rapid in the solum and rapid in the substratum. The root zone is deep, and the available water capacity is low. The organic matter content is moderately low. Reaction in the subsoil is medium acid to neutral. The 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 for crops. It is suited to row crops and small grains and to pasture. The main limitation to these uses is droughtiness. Wind erosion is a hazard. Conservation tillage which leaves crop residue on the surface, planting winter cover crops, and returning crop residue to the plow layer or adding other organic material reduce wind erosion and delay surface drying. If this soil is used for pasture, grazing should be restricted when the soil is too dry to protect the plant population.

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 and livestock excluded.

This soil is well suited as sites for buildings. It is moderately well suited to septic tank absorption fields; however, nearby ground water may be polluted because of the poor filtering capacity of the sandy material. Shallow excavations tend to slump, especially when the soil is wet. Construction sites are subject to wind erosion when the soil is dry and bare of vegetative cover. Establishing or maintaining grass for lawns is difficult because of droughtiness. Small stones are a limitation for most recreational uses of the soil.

This soil is in capability subclass IIIs and woodland suitability group 3s.

OtB—Ottokee fine sand, 0 to 6 percent slopes. This gently sloping, moderately well drained soil is on beach ridges, sand dunes, and moraines. Most individual areas are oval on knolls and long and broad on ridges. They range from 2 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sand about 8 inches thick. The subsurface layer is about 52 inches thick. The upper part is yellowish brown, light yellowish brown, and pale brown, loose fine sand. The lower part is light brownish gray and pale brown, loose loamy fine sand. The subsoil is thin horizontal bands of strong brown, very friable loamy fine sand mixed with the fine sand from the lower part of the subsurface layer. The substratum to a depth of about 78 inches is gray, loose fine sand. In some areas the yellowish brown subsoil is at the surface. In places the strong brown and yellowish brown bands in the subsoil are fine sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Tedrow soils. The Tedrow soils are on flats and at the base of slopes. Also included are the very poorly drained Granby and Gilford soils, which are in low wet spots and along drainageways. These included soils make up about 15 percent of the unit.

Runoff is slow on this Ottokee soil. Permeability is rapid, and available water capacity is low. The root zone is deep. It is moderately acid to neutral. This soil has a seasonal high water table that is about 2 to 3.5 feet below the surface during extended wet periods. The surface layer has low organic matter content.

Most areas of this soil are used for farming. This soil is suited to corn, soybeans, and wheat and to pasture and specialty crops (fig. 10). The main management concern is droughtiness, but the hazard of wind erosion and a seasonal high water table are also limitations. This soil is ususally eroded by wind after it is cultivated and before the new crop is large enough or dense enough to protect the surface. Returning crop residue to the plow layer or the regular addition of other organic material helps resist wind erosion and delays drying of the surface soil. Conservation tillage that leaves crop residue on the surface and winter cover crops help prevent excessive soil loss. Pasturing is limited by droughtiness. Controlled grazing should be used to protect the quality of plant cover.

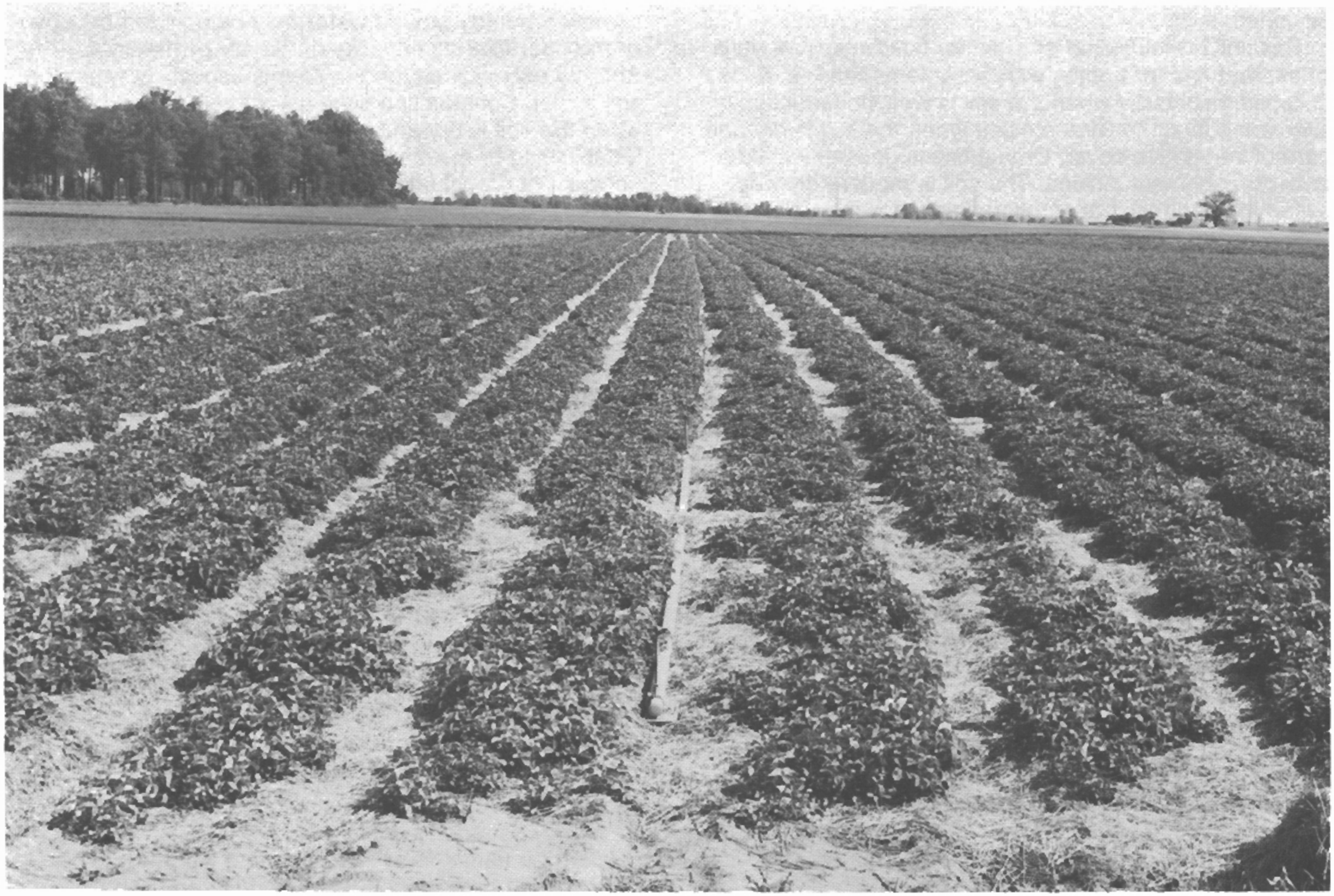


Figure 10.—Ottokee fine sand, 0 to 6 percent slopes, is suited to strawberries if irrigated.

Some areas are in woodland. This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. New seedlings may need to be irrigated during the driest time of the year to help them become established.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal water table. It is moderately well suited to septic tank absorption fields because of the seasonal high water table and poor filtering capacity of the sandy material. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Walls of shallow excavations tend to slump, especially when wet. During construction the soils are bare of vegetation and are subject to wind erosion. Seeding grass should be completed as soon as possible to reduce soil loss. If this soil is used for septic tank absorption fields, groundwater pollution is a hazard. Establishing and maintaining grass for lawns may be difficult because of droughtiness of this soil, especially during the dry months. Sandy textures limit most recreational uses.

This soil is in capability subclass IIIs and woodland suitability group 3s.

OuB—Ottokee-Glynwood complex, 3 to 8 percent slopes. This map unit consists of gently sloping, moderately well drained soils that were reworked by lake water. Individual areas are oval on knolls and long and broad on ridges of the Defiance Moraine. They range from 4 to 50 acres in size. They are made up of 55 to 70 percent Ottokee soils and from 20 to 40 percent Glynwood soils. Ottokee soils are on the convex, upper part of the side slopes and on the broader ridgetops. Glynwood soils are on the lower part of side slopes and sharp breaks of slopes. Ottokee soils are usually on one side and the top of knolls, and Glynwood soils are on the other side. Individual areas of the two soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Ottokee soil has a surface layer of very dark grayish brown, very friable fine sand about 8 inches thick. The subsurface layer is about 52 inches thick. The upper part is yellowish brown, light yellowish brown, and pale brown fine sand that is loose. The lower part is light brownish gray and pale brown, loose loamy fine sand. The subsoil is thin horizontal bands of strong brown and yellowish brown, very friable loamy fine sand, mixed with loamy fine sand from the lower part of the subsurface layer. In places the strong brown and yellowish brown bands are fine sandy loam.

Typically, the Glynwood soil has a surface layer of dark grayish brown loam about 6 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown and brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam. In places the surface layer is loamy fine sand.

Included with these soils in mapping are small areas of Fulton, Seward, and Tuscola soils. Fulton soils are somewhat poorly drained and in low spots and on side slopes. Seward soils are coarse textured in the surface layer and upper part of the subsoil and moderately fine or fine textured in the lower part of the subsoil and the substratum. They are on ridgetops and side slopes. Tuscola soils formed in stratified silt and fine sand. They are found on side slopes. Included soils make up 5 to 20 percent of the map unit.

Surface runoff is slow on the Ottokee soil and medium on the Glynwood soil. Permeability is rapid in the Ottokee soil and slow in the Glynwood soil. The available water capacity is low in the Ottokee soil and moderate in the Glynwood soil. These soils have a deep root zone. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to moderately alkaline in the lower part. These soils have a seasonal high water table that is in the subsoil during extended wet periods. The organic matter content in the surface layer is low or moderately low.

Most areas of these soils are used for crops or as woodland. They are suited to corn, soybeans, and wheat and to pasture. The main management concern is droughtiness, but a hazard of erosion and the seasonal high water table are also limitations. Wind erosion is a major problem on the Ottokee soil. This soil usually is eroded by wind after it is cultivated and before the new crop is large enough or dense enough to protect the surface. Erosion by water is a concern on the Glynwood soil (fig. 11). Returning crop residue to the plow layer or the regular addition of other organic material resists wind erosion and delays drying of the surface. Random subsurface drainage reduces wetness in seep spots and low spots. Proper cultivation and the depth at which seeds are planted are problems because of abrupt changes in surface texture. Conservation tillage that leaves crop residue on the surface and planting winter cover crops help prevent excessive soil loss. Pasturing is limited by droughtiness. Controlled grazing should be used to protect the quality of plant cover.

Figure 11.—Gully erosion on the Ottokee-Glynwood complex, 3 to 8 slopes. Erosion control practices are needed if these soils are used for row crops.

The soils in this unit are suited to trees. Species selected for planting should be tolerant of droughtiness. New seedlings may need to be irrigated during the driest time of the year to help them become established. Plant competition can be reduced by spraying, mowing, or disking.

The soils in this unit are moderately well suited as sites for buildings because of the seasonal high water table. They are moderately well suited to septic tank absorption fields because of the seasonal high water table in both soils, the slow permeability of the Glynwood soil, and the poor filtering capacity of the Ottokee soil. The water table can be lowered by subsurface drainage where outlets are available. The walls of shallow excavations in the Ottokee soil tend to slump. Buildings on the boundary of the two soils can settle unevenly, and corrosion of concrete and metal can increase. Sandy texture and wetness are limitations for most recreational uses of these soils.

These soils are in capability subclass IIIs. The Ottokee soil is in woodland suitability subclass 3s, and the Glynwood soil is in woodland suitability group 2c.

PeB—Perrin sandy loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is mainly on outwash plains, terraces, and beach ridges. It is in long narrow areas on ridges and in oval areas on knolls. Most areas range from 2 to 10 acres in size.

Typically, the surface layer is dark brown sandy loam about 12 inches thick. The subsoil is dark yellowish brown, friable sandy loam about 18 inches thick. The substratum to a depth of about 60 inches is yellowish brown, friable gravelly sandy loam. In some areas more clay is in the surface layer and subsoil. In places the substratum is gravelly sand.

Included in mapping at the base of slopes are small areas of Rawson soils, which have clayey material within a depth of 40 inches. Also included are areas of the very poorly drained Millgrove soils and somewhat poorly drained Digby soils in low positions on the landscape and along drainageways. These included soils make up about 15 percent of this map unit.

Runoff is medium on this Perrin soil. Permeability is moderately rapid. The organic matter content is moderate. The root zone is deep, and the available water capacity is low. Reaction in the subsoil is medium acid to neutral. A water table is 2 to 3.5 feet from the surface during extended wet periods.

In most areas this soil is used for crops. It is suited to corn, soybeans, and wheat and to pasture. The main management concern is droughtiness, but the hazard of wind erosion and a seasonal high water table are also limitations. Conservation tillage that leaves crop residue on the surface, planting winter cover crops, and returning crop residue to the plow layer or adding other organic material help to delay surface drying and reduce wind erosion. This soil is eroded by wind after it is cultivated and before the new crop is large enough or dense enough to protect the surface of the soil. If this soil is used as pasture, grazing should be restricted during dry periods to protect the quality of plant cover.

This soil is suited to trees. Species selected for planting should be tolerant of some droughtiness. If this soil is used as woodland, the undesirable species and poorly formed trees should be removed and livestock excluded. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings because of the seasonal high water table. It is moderately well suited to septic tank absorption fields because of the seasonal high water table and the poor filtering capacity of the substratum. If used for homesites, this soil is better suited to houses without basements than to those with basements. Where outlets are available the water table can be lowered by a subsurface drainage system. Building sites should be graded so that surface water is drained away from the building foundation. Pollution of nearby ground water may be a problem if the soil is used for septic tank absorption fields. Local roads and streets may be damaged 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 to lessen these problems. Small stones and wetness are limitations for most recreational uses of this soil.

This soil is in capability subclass IIIs and woodland suitability subclass 2o.

Pm—Pewamo clay loam. This nearly level, very poorly drained soil is on moraines and till plains. Slope is 0 to 2 percent. The soil is in irregularly shaped, broad areas on flats and in long, narrow, concave areas along drainageways. It receives runoff from adjacent higher lying soils and is subject to ponding. Most individual areas range from 2 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, firm clay loam about 10 inches thick. The subsoil is about 47 inches thick. It is dark gray and gray, mottled, firm clay loam, clay, and silty clay. The substratum to a depth of about 60 inches is gray and dark yellowish brown, firm silty clay loam. In some areas carbonates are within 20 inches of the surface. In other areas the surface layer is sandier.

Included with this soil in mapping are small areas of somewhat poorly drained Blount and Haskins soils on slight rises. Also included are small areas of Mermill soils, which have more sand in the surface layer and subsoil than the Pewamo soil. These included soils make up about 10 percent of most map units.

Runoff is very slow, or this Pewamo soil is ponded. Permeability is moderately slow. In drained areas the soil has a deep root zone and moderate or high available water capacity. Reaction in the subsoil is slightly acid or neutral. This soil has a seasonal high water table that is at or near the surface during extended wet periods. The organic matter content is high.

Most areas of this soil are used for crops. Corn, soybeans, and small grains are the principal crops. A few areas are in woodland. Wetness is a moderate limitation when this soil is used as cropland. Unless adequate drainage is provided, seedling stands emerge slowly and are thin, and yields are reduced. Subsurface drains are commonly used to remove excess water from the root zone. Drainage helps to improve plant growth and allow this soil to dry out earlier. Using cover crops and returning crop residue to the soil improve tilth and increase infiltration of water. If this soil is used for pasture, controlling grazing when the soil is wet reduces compaction.

This soil is suited to trees and to habitat for wetland wildlife. Use of harvesting equipment during wet seasons is limited. Seedling mortality, windthrow hazard, and plant competition are other management concerns. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Plant competition can be reduced by spraying, mowing, or disking. Tree species that tolerate wetness should be selected for new plantings. Improving woodland for timber production requires exclusion of livestock and removal of undesirable species and poorly formed trees. This soil is well suited to shallow water impoundments and wetland plants.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of the seasonal high water table, moderately slow permeability, and local surface ponding. If used as a homesite, this soil is better suited to houses without basements than to those with basements. Building sites should be landscaped so that surface water is diverted away from foundations. Water from eavespouts should be drained away from the house to reduce wetness. Local roads and streets may be damaged by ponding, low soil strength, and frost action. Drainage and suitable base material should be used to lessen these problems. Wetness limits most recreational uses of this soil.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Ps—Psammaquents, nearly level. This map unit consists of areas of sand or loamy sand that are left after sandy ridges have been removed. Sandy ridges on the Oakville, Oshtemo, Ottokee, and Spinks soils either have been removed or partly excavated and used as fill for urban construction. The areas that are left are either nearly level soils or are pits in the surrounding ridge. Reaction of the remaining soil ranges from neutral to moderately alkaline. Individual areas of this unit range from 2 to 20 acres in size.

Included in mapping are small areas of very poorly drained Granby soils and somewhat poorly drained Tedrow soils. Also included are a few areas of soils on partial ridges that have been disturbed. Included soils make up about 15 percent of this map unit.

These soils are used for open spaces and building sites. Some areas are farmed. In most areas the soil is calcareous at or near the surface and has a seasonal high water table. Plants and grasses that are tolerant of water and alkaline soil should be selected for planting. Artificial drainage can be successfully used if adequate outlets are available. The soils are also subject to wind erosion unless protected by vegetative cover.

Psammaquents are poorly suited as sites for buildings because of the seasonal high water table. Dwellings and small buildings without basements are better suited to these soils than to those with basements.

These soils are poorly suited to septic tank absorption fields because of the seasonal wetness and the rapid permeability. These limitations could cause pollution of ground water. The soils are poorly suited to lawns and gardens. Local streets, roads, and parking lots need to be drained and need a good road subbase. Shallow excavations in these soils tend to become wider as the walls slump.

This soil is not assigned to a capability subclass.

RbB—Rawson sandy loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on beach ridges and outwash plains. It is in long narrow areas on ridges and in oval areas on knolls. Most individual areas range from 2 to 10 acres.

Typically, the surface layer is dark brown, friable sandy loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, mottled, friable sandy loam. The middle part is dark yellowish brown, mottled, firm clay loam. The lower part is dark brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is brown, mottled, very firm clay loam. In some areas the surface layer and upper part of the subsoil have more sand.

Included with this soil in mapping are narrow strips of very poorly drained Mermill soils in drainageways and depressions. Also included are small areas of somewhat poorly drained Haskins soils that are nearly level. These included soils make up about 15 percent of this map unit.

Runoff is medium on this Rawson soil. Permeability is moderate in the upper part of the solum and slow or very slow in the lower part of the solum and in the substratum. The root zone is deep, and the available water capacity is moderate. Reaction in the subsoil ranges from medium acid to mildly alkaline. The organic matter content is moderately low or low. This soil has a seasonal water table that is about 2.5 to 4 feet below the surface during extended wet periods.

Most areas of this soil are used for farming. This soil is suited to corn, soybeans, and wheat and to pasture. The main management concern is erosion. Winter cover crops, conservation tillage that leaves crop residue on the surface, and grassed waterways help to control erosion. Returning crop residue to the plow layer or adding other organic material helps to control erosion and improve fertility and tilth. Natural drainage is generally adequate, but random tile lines are beneficial in draining wet spots and seeps. If this soil is used for pasture, controlling grazing when the soil is wet reduces compaction and plant damage.

This soil is suited to growing trees. Improving woodland for timber production requires exclusion of livestock and removal of undesirable species and poorly formed trees. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table and moderate shrinking and swelling. It is poorly suited to septic tank absorption fields because of the seasonal high water table and slow or very slow permeability. Buildings without basements are better suited to this soil than those with basements. Backfilling with pervious material and using poured, reinforced concrete basement walls and footings reduce cracking caused by the moderate shrinking and swelling of the soil. If outlets are available, the water table can be lowered by subsurface drainage. Local roads and streets are subject to damage caused by frost action. Slow or very slow permeability is a limitation for recreational uses of the soil.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

RnA—Rimer loamy fine sand, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on beach ridges, deltas, and outwash plains. It is on low ridges or knolls. Most individual areas range from 2 to 10 acres in size.

Typically, this soil has a surface layer of dark brown, very friable loamy fine sand about 9 inches thick. The subsurface layer to a depth of 23 inches is yellowish brown, mottled, very friable fine sand. The subsoil is about 10 inches thick. The upper part is dark yellowish brown, mottled, very friable fine sandy loam. The lower part is grayish brown, mottled, firm clay. The substratum to a depth of about 60 inches is gray and dark yellowish brown, mottled, very firm silty clay loam.

Included with this soil in mapping are small areas of Blount, Haskins, Nappanee, and Tedrow soils. Also included are moderately well drained Seward and Ottokee soils on slightly higher rises and very poorly drained Mermill soils in low spots. Blount and Nappanee soils have finer texture in the subsoil than the Rimer soil. They are commonly at the base of slopes. Haskins soils have more clay in the subsoil and are on side slopes. Tedrow soils have sandy texture more than 40 inches deep and are on side slopes or ridge crests. Included soils make up about 15 percent of this map unit.

In this Rimer soil, permeability is rapid in the upper part of the solum and is very slow or slow in the lower part of the solum and in the substratum. In drained areas this soil has a deep root zone and moderate available water capacity. Reaction in the subsoil is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. Runoff is slow. This soil has a seasonal high water table that is near the surface during extended wet periods. The organic matter content is moderately low.

Most areas of this soil are used for crops. This soil is suited to row crops and small grains and to pasture. Drainage of the soil is the main management concern. Subsurface drainage is commonly used to lower the water table. Wind erosion may be a concern when the surface of this soil is dry and bare of vegetative cover. Cover crops and leaving crop residue on the surface help control erosion and maintain the organic matter content.

This soil is well suited to growing trees. Species selected for planting should be tolerant of droughtiness. Seedling mortality can be reduced by mulching, planting during spring when moisture supply is best, and controlling weeds. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings, but it is limited by the seasonal high water table. It is poorly suited to septic tank absorption fields because of the seasonal high water table and slow or very slow permeability. Building sites should be landscaped and graded to drain away from the foundation. The water table can be lowered by subsurface drainage where outlets are available. Backfilling with pervious material and using poured, reinforced concrete basement walls and footings reduce cracking caused by shrinking and swelling of the soil. Local roads and streets may be damaged by frost action. Drainage and suitable base materials should be used to lessen this problem. Wetness and slow or very slow permeability are limitations for many recreational uses of the soil.

This soil is in capability subclass IIw and woodland suitability group 2s.

SdB—Seward loamy fine sand, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on beach ridges, outwash plains, and deltas. Most individual areas are oval on knolls and long and broad on ridges. They range from 2 to 15 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 10 inches thick. The subsurface layer, between depths of 10 and 22 inches, is yellowish brown, very friable loamy fine sand. The subsoil is about 18 inches thick. The upper part is dark brown, very friable sandy loam; the middle part is dark yellowish brown, mottled, friable sandy loam; and the lower part is dark brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is brown, mottled, very firm clay loam.

Included in mapping are small areas where the slope is more than 6 percent. Also included are areas of somewhat poorly drained Rimer soils in small depressions and very poorly drained Wauseon soils at the base of slopes. Ottokee soils, which are sandy to a greater depth than this Seward soil, are on the crest of knolls. These included soils make up about 15 percent of this unit.

Runoff is slow on this Seward soil. 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. Reaction in the subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The seasonal high water table is at a depth of about 3 feet during extended wet periods.

In most areas this soil is used for crops or as woodland. This soil is suited to row crops and small grains and to 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, subsurface drainage 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 on the more sloping soils during hard rains. Cover crops, adding crop residue to the plow layer, and conservation tillage that leaves crop residue on the surface help control erosion.

This soil is well suited to trees. Seedling mortality can be reduced by mulching, by planting during the spring when moisture supply is best, and by controlling weeds. Plant competition can be reduced by spraying, mowing, or disking. If this soil is used for timber production, livestock should be excluded from the woodland and the undesirable species and poorly formed trees should be removed.

This soil is moderately well suited as sites for buildings, but it is limited because the coarse and moderately coarse material slumps and the moderately fine and fine material shrinks and swells. It is moderately well suited to septic tank absorption fields because of wetness and slow or very slow permeability. Using reinforced, poured concrete for basement walls and footings and backfilling with pervious material reduce the chance of cracking walls. Coating the exterior of basement walls or placing drains at the base of footings may be necessary if basements are in wet areas. Subsurface drainage reduces the wetness around septic tank absorption fields. Damage to local streets and roads from frost action can be reduced by providing artificial drainage and by using a suitable base material. Slow permeability limits most recreational uses of the soil.

This soil is in capability subclass IIe and woodland suitability group 2s.

SdC—Seward loamy fine sand, 6 to 12 percent slopes. This moderately sloping, moderately well drained soil is on beach ridges, outwash plains, and deltas. Most individual areas are long and broad and on ridges. They range from 2 to 10 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 8 inches thick. The subsurface layer between depths of 8 and 24 inches is yellowish brown, very friable loamy fine sand. The subsoil is about 11 inches thick. The upper part is dark yellowish brown, mottled, friable sandy loam, and the lower part is brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is dark brown, mottled, very firm clay loam.

Included in mapping are small areas of soils where the slope is less than 6 percent or more than 12 percent. Also included are areas of somewhat poorly drained Rimer soils in small depressions and very poorly drained Wauseon soils at the base of slopes. These included soils make up about 15 percent of this unit.

Runoff is medium on this Seward soil. 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 or neutral in the upper part and neutral or mildly alkaline in the lower part. The water table is at a depth of about 3 feet during extended wet periods.

In most areas this soil is used for crops or as woodland. This soil is suited to row crops and small grains and to pasture. The hazards of erosion and droughtiness are the main limitations to these uses. In some areas drainage needs to be improved to reduce wetness. If necessary, subsurface drainage can be used to lower the water table and drain seep spots. Wind erosion is a hazard if the soil is dry and bare of vegetation. Water erosion is a hazard after a hard rain. Cover crops, adding crop residue to the plow layer, and conservation tillage that leaves crop residue on the surface help control erosion.

This soil is well suited to trees. Plant competition can be reduced by spraying, mowing, or disking. Seedling mortality can be reduced by mulching, by planting during the spring when moisture supply is best, and by controlling weeds. If this soil is used for timber production, livestock should be excluded from the woodland and the undesirable species and poorly formed trees should be removed.

This soil is moderately well suited as sites for buildings, but it is limited because the coarse and moderately coarse material slumps and the moderately fine and fine material shrinks and swells. It is moderately well suited to septic tank absorption fields because of wetness and slow or very slow permeability. Using reinforced, poured concrete for basement walls and footings and backfilling with pervious material reduce the chance of cracking of walls. Coating the exterior of basement walls or placing drains at the base of footings may be necessary if basements are in wet areas. Subsurface drainage reduces the wetness around septic tank absorption fields. Damage to local streets and roads from frost action can be reduced by providing artificial drainage and using a suitable base material. Slow permeability limits most recreational uses of the soil.

This soil is in capability subclass IIIe and woodland suitability subclass 2s.

SfB2—Shinrock silty clay loam, 2 to 6 percent slopes, eroded. This is a gently sloping, moderately well drained soil on lake plains. It is in long, narrow areas on breaks of slopes along drainageways. Individual areas range from 2 to 15 acres.

Typically, the surface layer is dark brown, firm silty clay loam about 7 inches thick. The subsoil extends to a depth of about 31 inches. It is yellowish brown and brown, very firm silty clay. The substratum to a depth of about 60 inches is mottled, brown, very firm silty clay.

Included in mapping are small areas of the somewhat poorly drained Fulton soils. Also included are the very poorly drained Latty soils in narrow areas along drainageways. Small areas of severely eroded soils are also included. The included soils make up about 15 percent of this map unit.

Runoff is medium on this Shinrock soil. Permeability is moderately slow, and the available water capacity is moderate. The root zone is deep. The organic matter content is moderately low. Reaction in the subsoil is slightly acid to moderately alkaline. The water table is 2 to 3.5 feet below the surface in spring.

In most areas this soil is used for crops. It is suited to row crops and small grains and to pasture. The hazard of erosion is the main limitation to these uses. Conservation tillage that leaves crop residue on the surface, cover crops, adding crop residue to the plow layer, and grassed waterways help reduce erosion. The surface tends to crust after a heavy rain. This hinders seedling emergence. Returning crop residue to the plow layer or the addition of other organic material helps reduce surface crusting. If this soil is used for pasture, grazing should be restricted when the soil is wet to reduce surface compaction and damage to plants.

This soil is suited to trees. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, by assuring good compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to less straight borders that will not produce wind pockets or wind tunnels. It this soil is used for timber production, livestock should be excluded from the woodland and the undesirable species and poorly formed trees should be removed.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table, slumping of excavation walls, and shrinking and swelling of the subsoil. It is moderately well suited to septic tank absorption fields because of the seasonal high water table and moderately slow permeability. Building sites should be graded to drain water away from the foundation and should be landscaped to protect the building site from erosion. The water table can be lowered by subsurface drainage where outlets are available. Damage to local roads and streets from frost action and low strength can be reduced by installing artificial drainage and by using a suitable base material. Wetness and slow permeability limit some recreation uses of this soil.

This soil is in capability subclass IIe and woodland suitability group 2c.

SfC2—Shinrock silty clay loam, 6 to 12 percent slopes, eroded. This moderately sloping, moderately well drained soil is on lake plains. It is in long, narrow areas on breaks of slopes along drainageways. Individual areas range from 2 to 10 acres.

Typically, the surface layer is brown, very firm silty clay loam about 5 inches thick. The subsoil extends to a depth of about 26 inches. It is brown, very firm silty clay. The substratum to a depth of about 60 inches is brown, mottled, very firm silty clay.

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

Runoff is rapid on this Shinrock soil. Permeability is moderately slow, and the available water capacity is moderate. The root zone is deep. The organic matter content is moderately low. Reaction in the subsoil is neutral to moderately alkaline. The water table is 2 to 3.5 feet below the surface in the spring.

Most areas of this soil are used for crops. This soil is suited to row crops and small grains and to pasture. The hazard of erosion is the main limitation to these uses. Conservation tillage that leaves crop residue on the surface, cover crops, adding crop residue to the plow layer, and grassed waterways help reduce erosion. The surface tends to crust after a heavy rain. This hinders seedling emergence. Returning crop residue to the plow layer or adding other organic material helps 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. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, by assuring good soil compaction to prevent cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. If this soil is used for timber production, livestock should be excluded from the woodland, and the undesirable species and poorly formed trees should be removed.

This soil is moderately well suited as sites for buildings, but it is limited by a seasonal high water table, slumping of excavation walls, and shrinking and swelling of the subsoil. It is moderately well suited to septic tank absorption fields because of the seasonal high water table and moderately slow permeability. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. The water table can be lowered by subsurface drainage where outlets are available. Seep spots may occur during wet periods or when septic tank absorption fields are used. Damage to local roads and streets from frost action and low strength can be reduced by providing artificial drainage and by using a suitable base material. Wetness, moderately low permeability, and slope limit recreational uses of this soil.

This soil is in capability subclass IIIe and woodland suitability group 2c.

SgB2—Shinrock-Tuscola complex, 3 to 8 percent slopes, eroded. This map unit consists of gently sloping, moderately well drained soils on broad ridges of the Defiance Moraine and on beach ridges that are reworked by lake waters. Individual areas of this unit range from 4 to 50 acres in size. They are made up of 40 to 60 percent Shinrock soils and 20 to 40 percent Tuscola soils. Shinrock soils are on convex side slopes and ridgetops. Tuscola soils are mainly on convex side slopes, but in some areas they are on ridgetops. Areas of the two soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Shinrock soil has a surface layer of brown, firm silty clay loam about 7 inches thick. The subsoil is brown, mottled, firm silty clay about 18 inches thick. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay. In places the substratum is within 15 inches of the surface. In other places stratified silt and very fine sand are below a depth of 40 inches.

Typically, the Tuscola soil has a surface layer of brown, friable fine sandy loam about 8 inches thick. The subsoil is about 30 inches thick. It is dark yellowish brown, mottled, friable loam and silt loam. The substratum to a depth of about 60 inches is dark yellowish brown and brown, mottled, friable, stratified silt loam, loamy very fine sand, and fine sand. In places stratified silty clay and silty clay loam are below a depth of 40 inches.

Included with these soils in mapping are small areas of Fulton, Galen, Kibbie, and Seward soils. Fulton and Kibbie soils are somewhat poorly drained and are at the base of slopes and in low parts of the landscape. Galen soils are sandy and have bands of sandy loam. They are at the top of slopes or at points where ridges change direction. Seward soils are sandy in the surface layer and the upper part of the subsoil and clayey in the lower part of the subsoil and in the substratum. They are on side slopes and ridgetops. These included soils make up 10 to 25 percent of the map unit.

Surface runoff is moderate on the Shinrock soil and medium on the Tuscola soil. Permeability is moderately slow in the Shinrock soil and moderate in the Tuscola soil. The available water capacity is moderate in the Shinrock soil and moderate or high in the Tuscola soil. The root zone in both soils is deep. Reaction in the subsoil of the Shinrock soil is slightly acid in the upper part and mildly alkaline in the lower part. Reaction in the subsoil of the Tuscola soil is medium acid in the upper part and neutral in the lower part. The organic matter content in the surface layer is moderately low in the Shinrock soil and moderate in the Tuscola soil.

Most areas of these soils are used for farming, but a few areas are in woodland. These soils are suited to row crops and pasture. Soil erosion is the main management concern. Using conservation tillage that leaves crop residue on the surface, planting cover crops, and using grassed waterways reduce soil loss by water and wind. On Shinrock soils, the surface tends to crust after heavy rains. This hinders seedling emergence. Returning crop residue to the plow layer or adding other organic material reduces surface crusting. Natural drainage is generally adequate during the growing season, but seeps do occur in the spring and delay fieldwork. These seeps are in Tuscola soils because of the coarser texture in the substratum material. Equipment may become stuck in the spring and after heavy rains. Random subsurface drainage may be needed to overcome these seeps. Controlled grazing should be used to reduce excessive soil compaction and damage to plants.

These soils are suited to trees and habitat for openland and woodland wildlife. Tree species that can tolerate clayey soil and wetness should be selected for new plantings. Improving woodland for timber production requires exclusion of grazing livestock and removal of undesirable species and poorly formed trees. Plant competition can be reduced by spraying, mowing, or disking.

These soils are moderately well suited as sites for buildings but are limited by a seasonal high water table, potential shrinking and swelling, and caving of excavated walls. They are moderately well suited to septic tank absorption fields because of the seasonal high water table and the moderately slow permeability of the Shinrock soil. Buildings that span both these soils may result in cracking of walls and footings because their subsoil and substratum settle at different rates. This also may cause increased corrosion of concrete and uncoated steel. The water table can be lowered by subsurface drainage. Using poured reinforced concrete for footings and basement walls reduces the chance of cracking walls. Building sites should be graded to provide good surface drainage away from the foundation and protect the site from erosion. Water from eavespouts should be diverted away from the foundation. Local roads and streets may be damaged by low soil strength, seeps, and frost action. Drainage and suitable base material should be used to lessen these problems. Wetness and moderately slow permeability limit most recreational uses of these soils.

These soils are in capability subclass IIe. The Shinrock soil is in the woodland suitability group 2c, and the Tuscola soil is in woodland suitability group 1o.

Sh—Shoals silt loam, frequently flooded. This nearly level, somewhat poorly drained soil is on flood plains. It is subject to frequent flooding. It is on broad flats and small, convex knolls. Most individual areas range from 2 to 10 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The upper part of the substratum is brown mottled, friable silty clay loam. The lower part of the substratum to a depth of about 60 inches is dark grayish brown and grayish brown, mottled, friable silt loam. In some areas the substratum is more sandy.

Included with this soil in mapping are narrow strips of very poorly drained Sloan soils along drainageways and in low wet spots. Small areas of moderately well drained Eel soils are on relatively higher parts of the landscape. These inclusions make up about 15 percent of most map units.

Runoff is very slow from the Shoals soil. Permeability is moderate. In drained areas the soil has a deep rooting zone and high or very high available water capacity. The substratum ranges from slightly acid to moderately alkaline. This soil has a seasonal high water table that is near the surface during extended wet periods. Organic matter content is moderate or high.

Most areas of this soil are used for farming or as woodland. This soil is well suited to crops and pasture. Drainage is commonly hindered by lack of proper outlets. If outlets are available, subsurface drainage is effective in lowering the water table for crop production. This soil is suited to most crops, but winter wheat may be damaged by flooding. Corn and soybeans can be grown, but flooding may delay planting. This soil is well suited to pasture, but grazing should be avoided when the soil is wet to protect against soil compaction and damage to plants.

This soil is well suited to growing trees. Species selected for planting should be tolerant of wetness. Plant competition can be reduced by mowing, spraying, or disking.

This soil is generally unsuited as sites for buildings and septic tank absorption fields because of the flooding and the seasonal high water table. Local roads and streets may be damaged by frost action and flooding. Constructing streets and roads on raised, well compacted fill material and providing adequate side ditches and culverts help overcome flooding and frost action. Flooding and wetness limit recreactional uses of the soil.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

So—Sloan silty clay loam, frequently flooded. This nearly level, very poorly drained soil is on flood plains of streams (fig. 12). It is on broad flats on smaller flood plains and in narrow, elongated strips at the base of slopes and along drainageways of larger flood plains. It is subject to frequent flooding. Slope is 0 to 2 percent. Most individual areas range from 4 to 60 acres in size.

Typically, this soil has a surface layer of very dark gray, firm silty clay loam about 12 inches thick. The subsoil is about 33 inches thick. The upper part is dark gray, mottled, firm silty clay loam, and the lower part is dark grayish brown and grayish brown, mottled, firm and friable clay loam. The substratum to a depth of about 60 inches is grayish brown, stratified silty clay loam and clay loam that is mottled and friable. In some areas the surface layer and subsoil contain more sand.

Included with this soil in mapping are small areas of somewhat poorly drained Shoals soils on slight rises. Also included, near present stream channels, are narrow elongated areas of the moderately well drained Eel soils. These inclusions make up about 15 percent of this map unit.

Runoff is very slow on this Sloan soil. Permeability is moderate or moderately slow. The root zone is deep, and the available water capacity is moderate or high. Reaction in the subsoil ranges from slightly acid to mildly alkaline in the upper part and from neutral to moderately alkaline in the lower part. This soil has a seasonal high water table that is at the surface during extended wet periods. The organic matter content is high.

Most areas of this soil are used for farming or as woodland. This soil is limited by flooding and wetness. Drainage is commonly hindered by the lack of proper outlets and the duration of floods. This soil is suited to most crops, but winter wheat may be damaged by flooding and ponding. Corn and soybeans can be grown, but flooding may delay planting. Also, logs, branches, and other debris from floods commonly are a hazard to farming. This soil is well suited to pasture, but grazing should be avoided when the soil is wet.

This soil is suited to growing trees. Species selected for planting should be tolerant of wetness. During wet seasons, use of tree harvesting equipment commonly is limited because of the wetness of the soil and the flooding. Seedling mortality, windthrow hazard, and plant competition are other management concerns. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Plant competition can be reduced by spraying, mowing, or disking.

This soil is generally unsuited as sites for buildings and septic tank absorption fields because of flooding and a seasonal high water table. Local roads and streets may be damaged by frost action, low soil strength, flooding, and wetness. Constructing roads and streets on raised, well compacted fill material and providing adequate side ditches and culverts help overcome flooding, frost damage, and wetness. Flooding and wetness limit many recreational uses of this soil.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

SpB—Spinks fine sand, 1 to 6 percent slopes. This gently sloping, well drained soil is on beach ridges, outwash plains, and moraines. Most individual areas are

Figure 12.—Sloan silty clay loam, frequently flooded, is suited to crops.

oval on knolls and are long and narrow on ridges and range from 2 to 15 acres in size.

Typically, the surface layer is dark brown, very friable fine sand about 8 inches thick. The subsurface layer is dark yellowish brown, very friable fine sand about 4 inches thick. The next 54 inches is yellowish brown, loose fine sand and thin, horizontal bands of strong brown, very friable loamy fine sand. The bands total 6 inches or more in thickness. The substratum to a depth of 80 inches is yellowish brown, loose fine sand. In some areas the horizontal bands are at the surface. In places, there is a 3- to 5-inch layer of yellowish brown fine sand over the original dark surface layer.

Included with this soil in mapping are small areas of the moderately well drained Ottokee soils and the somewhat poorly drained Tedrow soils, which are in low parts of the landscape. Also included are Granby soils, which are in low, wet spots and drainageways. These inclusions make up about 15 percent of most areas.

Runoff is slow on this Spinks soil. Permeability is moderately rapid. The soil has a deep root zone and low available water capacity. Reaction in the root zone ranges from medium acid to neutral. The organic matter content is moderate.

Most areas of this soil are used for farming or as woodland. This soil is suited to row crops and small grains and to pasture. The main management concern is droughtiness. Wind erosion is a hazard after this soil is cultivated and before the new crop is high enough or dense enough to protect the surface of the soil. Conservation tillage that leaves crop residue on the surface and winter cover crops help prevent excessive soil loss. Returning crop residue to the plow layer or the regular addition of other organic materials helps resistance to wind erosion and delays drying of the surface. Controlled grazing should be used to protect the quality of plant cover.

This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. Woodland management should include removal of undesirable species and poorly formed trees. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, and by controlling weeds.

This soil is well suited as a site for buildings and septic tank absorption fields. Walls of shallow excavations tend to slump. Construction sites are subject to wind erosion when the soil is dry and bare of vegetative cover. The sandy texture is limiting for most recreational uses of this soil.

This soil is in capability subclass IIIs and woodland suitability group 3s.

SpC—Spinks fine sand, 6 to 12 percent slopes. This moderately sloping, well drained soil is on beach ridges, outwash plains, and moraines. Most individual areas are long and narrow on ridges and irregularly shaped on knolls. They range from 2 to 10 acres in size.

Typically, the surface layer is brown, loose fine sand about 8 inches thick. The subsurface layer is yellowish brown, loose fine sand about 10 inches thick. The next layer, about 46 inches thick, is alternating yellowish brown, loose fine sand and brown, friable loamy fine sand. The substratum to a depth of about 80 inches is yellowish brown, loose fine sand. In some areas the yellowish brown fine sand is at the surface or forms a 3- to 5-inch layer overlying the brown surface layer.

Included with this soil in mapping are small areas of the moderately well drained Ottokee soils and the somewhat poorly drained Tedrow soils, which are in low parts of the landscape. Also included are Granby soils, which are in low, wet spots and along drainageways. These included soils make up about 15 percent of the map unit.

Runoff is medium on this Spinks soil. Permeability is moderately rapid. The soil has a deep root zone and a low available water capacity. Reaction in the root zone is medium acid in the upper part and neutral in the lower part. The organic matter content is moderate.

Most areas of this soil are used for farming or as woodland. This soil is suited to row crops and small grains and to pasture. Erosion is the main management concern. The hazard of drought is severe. Erosion by water occurs mainly during periods of heavy rains where the soil is bare. Winds erode after this soil is cultivated and before the new vegetation is high enough or dense enough to protect the surface. Conservation tillage that leaves crop residue on the surface and winter cover crops help prevent excessive soil loss. Returning crop residue to the plow layer or the regular addition of other organic materials helps resistance to wind erosion and delays drying of the surface. Controlled grazing should be used to protect the quality of plant cover.

This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. Seedling mortality can be reduced by mulching, by planting during spring when moisture supply is best, and by controlling weeds.

This soil is well suited as a site for buildings and septic tank absorption fields. Slope is somewhat limiting. Buildings and septic tank absorption fields need to be located on the contour. Construction sites are subject to wind erosion when the soil is dry and bare of vegetative cover. Walls of shallow excavations tend to slump. The sandy texture is the limiting factor for most recreational uses of this soil.

This soil is in capability subclass IIIe and woodland suitability group 3s.

SpD—Spinks fine sand, 12 to 18 percent slopes. This moderately steep, well drained soil is on beach ridges, outwash plains, and moraines. Most individual areas are long and narrow on ridges and side slopes along drainageways or are irregularly shaped. They range from 2 to 10 acres in size.

Typically, the surface layer is dark brown, very friable fine sand about 5 inches thick. The surface layer is yellowish brown, loose fine sand about 4 inches thick. The next layer, about 48 inches thick, is yellowish brown, loose fine sand that has thin horizontal bands of brown and strong brown, friable loamy fine sand. The horizontal bands total 6 inches or more in thickness. The substratum to a depth of about 72 inches is yellowish brown, loose fine sand. In some areas the yellowish brown fine sand is at the surface.

Included with this soil in mapping are small areas of the moderately well drained Ottokee soil, which are in low parts of the landscape. Also included are Granby soils, which are at the base of slopes and along drainageways. These included soils make up about 15 percent of the unit.

Runoff is rapid on this Spinks soil. Permeability is moderately rapid. The soil has a deep root zone and low available water capacity. Reaction in the root zone is medium acid to neutral. The organic matter content is moderate.

Most areas of this soil are used for pasture and as woodland. This soil is suited to pasture, but when crops are grown, erosion is a severe problem. Soil erosion is the main management concern, but drought is a severe hazard. This soil is eroded by water mainly during periods of heavy rains where there is little or no vegetative cover. Conservation tillage that leaves crop residue on the surface and winter cover crops help prevent excessive soil loss when this soil is cultivated. Pasturing is limited by the loose surface sand and droughtiness. Overgrazing reduces the plant population. Winds erode pastures usually in late spring after livestock has reduced the plant population.

This soil is suited to trees. Species selected for planting should be tolerant of droughtiness. Seedling mortality can be reduced by mulching, by planting during spring when the moisture supply is best, and by controlling weeds. Woodland management should include removing undesirable species and poorly formed trees and excluding livestock.

This soil is moderately well suited as sites for buildings and septic tank absorption fields, but it is limited by slope. Walls of shallow excavations tend to slump, particularly when the soil is wet. Construction sites are subject to wind erosion when the soil is dry and bare of vegetative cover. When this soil is used for septic tank absorption fields, there is a possibility of seep spots forming on the hillside. Slope and the sandy texture are limitations for most recreational uses.

This soil is in capability subclass IVe and woodland suitability group 3s.

TdA—Tedrow loamy fine sand, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on beach ridges and outwash plains. It is in long narrow areas on low ridges and in oval areas on low knolls. Most individual areas range from 2 to 20 acres.

Typically, this soil has a surface layer of very dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsoil is about 17 inches thick. It is dark yellowish brown and brown, mottled, loose loamy fine sand. The substratum to a depth of about 60 inches is grayish brown, mottled, loose fine sand. In places clayey material is in the substratum between depths of 40 and 60 inches. In other areas discontinuous sandy loam bands are in the subsoil.

Included with this soil in mapping are small areas of the moderately well drained Ottokee soils and the very poorly drained Granby soils. Included soils make up about 15 percent of this map unit.

Runoff is slow on this Tedrow soil, and permeability is rapid. In drained areas the soil has a deep root zone. The available water capacity is low. Reaction in the subsoil is slightly acid or neutral. This soil has a seasonal high water table that is in the subsoil during extended wet periods. Organic matter content is moderate.

Most areas of this soil are used for farming. The soil is suited to crops, to pasture, and to woodland. Droughtiness, wind erosion, and drainage are management concerns. Returning crop residue to the plow layer or regularly adding other organic material delays the drying of the surface soil and reduces wind erosion (fig. 13). Seeds may be uncovered or young plants may be damaged by blowing soil during periods in the spring. Crop residue left on the surface reduces erosion by wind. Subsurface drainage is commonly used to lower the water table where adequate outlets are available. Livestock should be restricted from grazing during wet periods to prevent excessive plant damage.

This soil is suited to trees. Tree species that can tolerate droughtiness should be selected for new plantings. Improving woodland for timber production requires exclusion of grazing livestock and removal of undesirable species and poorly formed trees.

This soil is moderately well suited as sites for buildings but is limited by a seasonal high water table. It is poorly suited to septic tank absorption fields because of a seasonal high water table and the poor filtering capacity of the sandy material. This soil is better suited to houses without basements than to those with basements. Building sites should be landscaped and graded to provide good surface drainage away from the foundation. Water from eavespouts should be diverted from the house. Local roads and streets may be damaged by wetness and frost action. Drainage and suitable base material should be used to lessen these problems. Wetness limits most recreational uses of this soil.

This soil is in capability subclass IIIs and woodland suitability group 3s.

TuB—Tuscola fine sandy loam, 3 to 8 percent slopes. This gently sloping, deep, moderately well drained soil is on beach ridges, outwash plains, and deltas. It is in narrow areas on breaks of slopes adjacent to drainageways and on side slopes of beach ridges. Most individual areas range from 2 to 20 acres in size.

Typically, the surface layer is brown, friable fine sandy loam about 10 inches thick. The subsoil is about 33 inches thick. The upper part is dark yellowish brown, friable and firm very fine sandy loam and loam. The lower part is dark yellowish brown, mottled, firm and friable silt loam. The substratum to a depth of about 60 inches is yellowish brown, very friable, stratified very fine sandy loam, loamy very fine sand, and very fine sand. In some areas the depth to the substratum is shallower.

Included with this soil in mapping are small areas of Galen soils on the top of slopes or on points of ridges, Shinrock soils on sides slopes, and the somewhat poorly drained Kibbie soils at the base of slopes and on other low parts of the landscape. Included soils make up about 15 percent of this map unit.

Runoff is medium on this Tuscola soil. Permeability is moderate. This soil has a deep rooting zone, and the available water capacity is moderate or high. Reaction in the subsoil is medium acid to mildly alkaline. This soil has a seasonal high water table that is in the subsoil during extended wet periods. The organic matter content is moderate.

Most areas of this soil are used for farming. This soil is suited to row crops and small grains and to pasture. Soil erosion is the main management concern. Soil loss may be excessive if the surface is bare of vegetative cover. Conservation tillage that leaves crop residue on the surface and cover crops help prevent excessive soil loss. Natural drainage is generally adequate for farming, but seep spots do form on the side slopes and at the base of the slopes. Random tile lines can be installed to overcome these seeps. Grazing should be controlled when the soil is wet to avoid damage to plants.

This soil is well suited to trees. Improving woodland for

Figure 13.—Crop residue on the surface of Tedrow loamy fine sand, 0 to 3 percent slopes, reduces erosion. This corn crop was planted with very little disturbance to the residue from the previous corn crop.

timber production requires exclusion of grazing livestock and removal of undesirable species and poorly formed trees. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as sites for buildings and septic tank absorption fields, but it is limited by a seasonal high water table. This soil is better suited to houses without basements than to those with basements. The walls of excavations tend to slump, especially when the soil is wet. Placing drains at the base of footings and coating the exterior of basement walls help prevent wet basements. Building sites should be graded to provide good surface drainage away from the foundation and protect the site from erosion. Water from eavespouts should be diverted away from the foundation. Local roads and streets may be damaged by frost action. Drainage and suitable base material should be used to lessen such damage. Wetness somewhat limits this soil for most recreation uses.

The soil is in capability subclass IIe and woodland suitability group 1o.

Uo—Udorthents, loamy. This map unit consists of nearly level to moderately sloping, dominantly loamy soils that have been greatly altered by construction activities. Individual areas include the highway interchange and maintenance area on the Ohio Turnpike, industrial site developments, sanitary landfills, and a few areas of borrow pits. Individual areas of this unit range from 4 to 40 acres in size.

The soil is typically loam, silt loam, silty clay loam, or clay loam. It is a mixture of material from the subsoil and substratum. In some places an appreciable amount of the surface layer, subsoil, or substratum has been removed, and in other places soil material has been added. Much of the original land surface has been graded. Because the higher slopes have been cut away and used as fill in depressions, the soil material is mixed and cannot be classified at the series level. A few areas are covered with bricks, cinders, stones, industrial waste, and trash.

This unit is not used for crops. The organic matter content and natural fertility are very low. Many graded areas have only sparse vegetation, and the soil is easily eroded. Grasses and legumes can be established by mulching, fertilizing, and seeding. Most areas are also suitable for trees, especially trees that can tolerate alkaline soils.

Many of these areas are used as building sites. Unequal settling and poor internal drainage are major problems when this soil is used as sites for buildings. Plants and grasses that are tolerant of alkaline soils should be used for lawns, gardens, trees, and shrubs. Local streets, roads, and parking lots need good underdrainage and a good subbase.

Capability subclass and woodland suitability group are not assigned.

Wf—Wauseon fine sandy loam. This nearly level, very poorly drained soil is on outwash plains, beach ridges, and deltas. It is in irregularly shaped areas on broad flats and in long, narrow depressions. This soil receives runoff from adjacent, higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most individual areas range from 4 to 60 acres in size.

Typically, the surface layer is black, friable fine sandy loam about 9 inches thick. The subsurface layer is about 4 inches thick. It is black, friable fine sandy loam. The subsoil is about 19 inches thick. It is dark gray, mottled, friable fine sandy loam in the upper part and dark gray, mottled, firm sandy clay loam in the lower part. The substratum to a depth of about 60 inches is gray, mottled, very firm silty clay loam. In some areas the surface and subsurface layers are loamy fine sand.

Included in mapping are areas of somewhat poorly drained Tedrow soils, which are on small oval rises or long, narrow ridges. Also included are areas of Gilford soils, which have more sand in the substratum, and Mermill soils, which contain more clay in the subsoil. These included soils make up about 15 percent of this map unit.

Runoff is very slow, or this Wauseon soil is ponded. Permeability is rapid in the upper part of the soil and very slow in the lower part 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 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 for crops. It is suited to corn, soybeans, and wheat and to pasture. If this soil is used for crops, drainage needs to be improved. If outlets are available, subsurface drainage can be used to lower the water table. In some areas the soil is ponded after a heavy rain, and crops may be damaged. Wind erosion is a hazard if this soil is dry and bare of vegetation. Leaving crop residue on the surface and the use of cover crops help reduce wind erosion and improve 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. Seedling mortality, windthrow hazard, and plant competition are other management concerns. Seedling mortality can be reduced by planting during spring to allow maximum root development before frost, by assuring good soil compaction to reduce cracking, and by controlling weeds. Windthrow can be reduced by plantation planting of species that will grow at uniform heights and by harvesting to leave straight borders that will not produce wind pockets or wind tunnels. Plant competition can be reduced by spraying, mowing, or disking.

This soil is poorly suited as sites for buildings and septic tank absorption fields because of the seasonal high water table, the hazard of ponding, and the very slow permeability in the lower part. This soil is better suited to houses without basements than to those with basements. The shrinking and swelling of the clayey material in the lower part of the subsoil and in the substratum is an added limitation to building houses that have a basement. Using poured, reinforced concrete basement walls and footings reduces the chance of walls cracking. Local roads and streets may be damaged by ponding water and frost action. If this soil is used for local roads and streets, drainage needs to be improved and a suitable base material used to lessen these problems. Wetness is a limitation for many recreational uses of the soil.

This soil is in capability subclass IIIw and woodland suitability group 3w.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited, and responsible levels of government, as well as individuals, must encourage and facilitate the use of prime farmland with wisdom and foresight.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland may now be in crops, pasture, woodland, or other land, but not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season, acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

About 181,000 acres, or nearly 70 percent of Fulton County, meets the soil requirements for prime farmland. The prime farmland is scattered throughout the county on almost every farm. Almost all the prime farmland is used for such crops as corn, soybeans, and wheat. A small percent is used for hay and pasture and as woodland. Corn and soybeans account for three-fourths of the acreage in prime farmland that is used for crop production.

A recent trend in land use in some parts of the county has been the loss of some prime farmlands to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate, and usually less productive.

Soil map units that make up prime farmland in Fulton County are listed in table 5. The extent of each listed map unit is shown in table 4. The list does not constitute a recommendation for a particular land use. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Soil Maps for Detailed Planning."

Some soils that have a high water table qualify for prime farmland only in areas where this limitation is overcome by drainage measures. In table 5, the need for these measures is indicated in parentheses after the map unit name. Onsite evaluation is necessary to see if the limitation has been overcome by corrective measures. In Fulton County the naturally wet soils generally have been adequately drained because of the application of drainage measures or because of incidental drainage that results from farming, roadbuilding, or other kinds of land development.

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 and pasture; as 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 wetness or very firm soil layers 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

This section was prepared by Frank E. Gibbs, district conservationist, Soil Conservation Service.

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 in table 6.

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

The principal crops of Fulton County are corn, soybeans, winter wheat, and alfalfa. Other crops that are grown to a lesser extent include tomatoes, potatoes, cucumbers used for pickles, and sunflowers grown for their seeds. Pasture accounts for less than 1 percent of the farmland acreage.

Specific characteristics and needed management for each soil can vary drastically across Fulton County. Some general practices, however, are necessary for most soils throughout the county.

Drainage is needed on the somewhat poorly drained and very poorly drained soils, which comprise approximately 75 percent of the cropland in the county. Ponding and excessive soil moisture not only reduce crop growth and delay planting in the spring, but also can result in compacted soil, increased runoff, and less efficient use of fertilizers.

Surface drainage, such as shallow field drains and large open ditches are the basis of a good drainage system. Ditches should be maintained and protected from sediment by sod berms, grassed filterstrips, brush removal, and vegetative cover. Subsurface drainage completes the system by providing good internal drainage to the soil. In certain situations, pump systems are needed where it is impractical or impossible to deepen the ditches for an adequate outlet.

Generally, subsurface drains are spaced at a much wider distance in sandy soils, such as the Granby, Gilford, and Tedrow soils, than in clayey soils. The clayey soils, such as the Blount, Fulton, Hoytville, and Pewamo soils, require closer spacing of subsurface drains in combination with surface drainage for optimum growth of crops and effectiveness of the drainage system.

Some soils, such as the Gilford, Granby, and Tedrow soils, have an unstable, very fine sandy material that can enter unprotected subsurface drains and plug the system. Subsurface drains in soils such as these should be protected with an approved filter to keep the sand out.

Erosion control practices are needed throughout the county to maintain the soil productivity of our farms and reduce sediment in our lakes and streams. Water erosion is the greatest hazard on heavy textured, sloping soils where infiltration is slow and surface water runs off the land carrying soil with it. Examples include the Blount, Glynwood, Shinrock, and Nappanee soils. Conservation tillage that leaves crop residue on the soil surface, grassed waterways, crop rotation, water control structures, and sod filter strips along ditches are important erosion control practices.

Wind erosion is a greater hazard than water erosion on bare, unprotected sandy or loamy soils, such as the Spinks, Ottokee, Tedrow, Oakville, Bixler, Kibbie, and Granby soils. Not only is the soil damaged by the erosion, but young seedling crops are also damaged or destroyed by the abrasive impact of the wind-blown material. Some specialty crops such as cucumbers used for pickles are especially susceptible. No-till, conservation tillage that leaves crop residues on the soil surface, field windbreaks, and vegetative cover crops help reduce wind erosion.

Availability of *soil moisture* can be critical to growth of crops on the well drained and moderately well drained sandy soils, such as the Spinks, Oakville, and Ottokee soils. Maintaining a good cover of mulch and using the same conservation practices that prevent wind erosion help hold needed moisture in the soil. Field windbreaks also can trap snow to provide moisture in the spring.

Soil fertility and fertilizing programs also vary depending on the type of soil. Natural fertility is lower in sandy soils, such as the Spinks, Oakville, and Rimer soils, than in loams or silty clay. This is caused by the low cation exchange capacity in sandy soils or their low capacity to hold nutrients. These sandy soils require frequent small applications of fertilizer. Loamy and clayey soils, however, can retain more nutrients for a longer period and require less frequent but larger applications. Additional information about specific fertilizing programs for crops, soil tests, and rates or kinds of fertilizer to apply can be obtained at the Cooperative Extension Service.

Soil tilth affects the germination and growth of crops. A soil that has good tilth has a granular structure and is porous. Compaction, loss of organic matter, and excessive tillage can adversely affect tilth. Conservation tillage, using cover crops such as legumes in rotations, proper animal waste disposal systems, and avoiding tillage when the soil is wet help maintain proper tilth.

Maintaining good tilth is most difficult in clayey soils, such as the Hoytville, Latty, and Pewamo soils. Unless the clayey soils are tilled within a very narrow range of moisture content, they clod or seal. Loamy soils, such as Colwood, Del Rey, Haskins, Mermill, and Tuscola soils, have a wider optimum range of moisture for tillage. Sandy soils, such as Oakville, Granby, Ottokee, and Tedrow soils, have the widest optimum range of moisture for tillage.

Pasture is a minor land use in Fulton County. Most of the pasture can be used as cropland, but some areas are too steep, infertile, or wet. Liming, fertilizing, brush control, seeding or renovation of adapted vegetation, and proper rotational grazing are essential for optimum production.

Specialty crops grown in Fulton County include orchards, vegetables, and trees and bushes in nurseries. Most specialty crops are grown in the eastern part of the county. Well drained soils best suited to orchards include the Ottokee, Seward, and Spinks soils. Tomatoes and cucumbers used for pickles are well suited to highly productive, dark colored soils, where a good artificial drainage system has been installed. Examples of these soils are the Colwood, Hoytville, Mermill, and Millgrove soils. Light colored soils cannot produce the color quality required of tomatoes. Many of the tomatoes are harvested with mechanical harvesters. On the clayey soils, such as Hoytville soils, yield averages may be reduced by 5 to 10 tons per acre if heavy rains occur when tomatoes are ready for harvest. Potatoes generally grow best in light colored sandy soils that have good drainage, such as Bixler, Ottokee, and Tedrow soils. Sunflowers can be grown on a wide variety of soils including light colored sands that are droughty or have low fertility. Nursery crops grown in sandy and loamy soils produce a good root stock and are easy to transplant.

Irrigation is a relatively minor practice in Fulton County because rainfall generally is adequate. Irrigation does play an important role in the production of fruit and vegetable crops of high value. Irrigation can not only supply extra moisture at critical periods of growth, but also can prevent frost damage to blossoms of some plants. Strawberries are one example. In general, soils that have a relatively high permeability are best suited to irrigation. Examples are the Ottokee, Tedrow, and Granby soils. Heavy clayey soils, such as the Hoytville, Latty, Nappanee, and Blount soils, are not as permeable and not as well suited to irrigation. Refer to table 17, "Physical and Chemical Properties of Soils," for more information on the permeability of each soil.

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 6. 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 6 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 woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey (*9*). 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 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

At the time of settlement, nearly all of Fulton County was woodland; today, a number of woodlots remain throughout the county. The main area of woodland is in the southeastern part of the county known as "Oak Openings" at Swan Creek Township. The Maumee State Forest is within this Oak Openings area of Fulton, Henry, and Lucas Counties. Also, many small woodlots dot the landscape within the Oak Openings. Goll Woods is a natural woodlot that has many areas of timber that has never been removed. It is controlled by the state of Ohio and is northwest of Archbold. Other major areas of woodland are around Winameg and Fayette.

In 1967, Fulton County had 21,264 acres of woodland, according to the 1971 Ohio Soil and Water Conservation Needs Inventory. Most of the woodlots have been cleared for cropland. Trees, however, are a valuable resource of lumber, firewood, and other wood byproducts. As woodlots continue to disappear, conservation and proper management of the remaining wood resources are needed.

Table 8 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; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 8, *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 strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

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.

Windbreaks and Environmental Plantings

In Fulton County windbreaks and environment plantings are becoming increasingly important as more woodlots are removed and the soils are used for crop production. Many soils, such as Oakville, Ottokee, Spinks, and Tedrow soils, are subject to wind erosion. These and other sandy soils are badly blown by southwesterly winds in the spring. Newly planted seeds are uncovered and small plants are damaged by the blowing sand. Also, southwestern and northwestern prevailing winter winds increase energy consumption and endanger livestock.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service; Ohio Department of Natural Resources, Division of Forestry; or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 10 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 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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

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 11, 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, timothy, 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, cherry, beech, maple, hawthorn, black walnut, hickory, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are 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, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, reed canarygrass, 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 shallow 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 woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and 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, shore birds, muskrat, and mink.

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, 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, 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 12 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, a cemented pan, or a very firm dense layer; 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 or to a cemented pan, 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 or to a cemented pan, 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 or to a cemented pan, 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 13 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 13 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 or to a cemented pan, 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 13 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 or to a cemented pan, 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 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, 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 14 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 index properties 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 14, 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 index properties.

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 low in content of soluble salts, 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, stones, or soluble salts, 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 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are 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 increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, 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, or organic matter. 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 or to a cemented pan, 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.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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 or to a cemented pan 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.

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 Index Properties

Table 16 gives estimates of the engineering classification and of the range of index 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 Their 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 as much as 15 or 20 percent of 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. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

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.

Physical and Chemical Properties

Table 17 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.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 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 are not considered flooding.

Table 18 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, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal 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 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, 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 18.

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.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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

Several soils in Fulton County are sampled and laboratory data were determined by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained on most samples include particle-size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations.

In addition to the data on soils of Fulton County, laboratory data on many of the same kinds of soils are also available from nearby counties. All are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil; and the Soil Conservation Service, State Office, Columbus, Ohio.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*10*). 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 19, 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. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement. The texture of the surface layer or substratum can differ within a series.

Soil Series and Their 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 (*8*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*10*). 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 "Detailed Soil Map Units."

Adrian Series

The Adrian series consists of deep, very poorly drained soils on outwash plains and in depressions on moraines. These soils formed in organic material 16 to 50 inches deep to sandy material. Permeability is moderately rapid. Slope is 0 to 2 percent.

Adrian soils commonly are adjacent to Granby, Pewamo, Tedrow, and Wauseon soils. Granby and Tedrow soils formed completely in sandy material. Pewamo soils formed in clay loam glacial till, and Wauseon soils formed in loamy material over fine or moderately fine textured materials that are within a depth of 40 inches.

Typical pedon of Adrian muck, about 2 miles south-southwest of Lyons, in Royalton Township; about 200 feet south and 1,220 feet west of the northeast corner of sec. 29, T. 9 S., R. 3 E.

Op—0 to 12 inches; black (N 2/0) sapric material, black (10YR 2/1) dry; 2 percent fiber, 0 percent rubbed; 15 percent fine sand; moderate medium granular structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

Oa—12 to 22 inches; very dark grayish brown (10YR 3/2) sapric material; very dark gray (10YR 3/1) dry; few fine distinct dark brown (7.5YR 4/4) mottles; 5 percent fiber, 2 percent rubbed; 20 percent fine sand; massive; friable; few fine roots; distinct layers are 1 mm thick because of natural deposition; neutral; clear smooth boundary.

Cg—22 to 60 inches; grayish brown (10YR 5/2) loamy fine sand; many fine distinct dark yellowish brown (10YR 4/4) mottles; single grained; loose; few thin layers of fine sandy loam; neutral.

The fiber content of the organic material is 0 to 15 percent. Sandy material is commonly at a depth of 16 to 50 inches.

The surface tier has hue of 10YR, 7.5YR, or N; 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 content of fine sand ranges from 0 to 20 percent. The subsurface tier has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 0 to 2. It is dominantly sapric material that is medium acid to neutral. It has a content of fine sand that ranges from 0 to 40 percent.

The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 to 6; and chroma of 1 or 2. It is fine sand, loamy fine sand, or gravelly fine sand. It ranges from neutral to moderately alkaline and contains free carbonates in some pedons.

Bixler Series

The Bixler series consists of deep, somewhat poorly drained soils on outwash plains, deltas, and beach ridges. These soils formed in sandy material 20 to 35 inches deep to stratified silty and sandy materials. Permeability is rapid in the upper part and moderate in the substratum. Slope ranges from 0 to 3 percent.

Bixler soils are commonly adjacent to Colwood, Dixboro, and Lamson soils and are similar to Rimer and Tedrow soils. Colwood soils have a mollic epipedon, are very poorly drained, and contain less sand than Bixler soils. Dixboro soils have more clay than Bixler soils and have less sand in the surface layer and in the upper part of the subsoil. Lamson soils are very poorly drained. Rimer soils have more clay in both the lower part of the subsoil and the substratum. Tedrow soils are more sandy throughout than the Bixler soils.

Typical pedon of Bixler loamy fine sand, 0 to 3 percent slopes, about 3 miles north of Tedrow, in Chesterfield Township; about 2,350 feet south and 880 feet west of the northeast corner of sec. 31, T. 9 S., R. 2 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) loamy fine sand; pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; common fine roots; medium acid; abrupt smooth boundary.

Bw1—10 to 16 inches; yellowish brown (10YR 5/6) loamy fine sand; very weak medium subangular blocky structure; very friable; common fine roots; neutral; gradual wavy boundary.

Bw2—16 to 22 inches; brownish yellow (10YR 6/6) loamy fine sand; weak medium subangular blocky structure; very friable; common fine roots; few fine faint dark brown (10YR 3/3) stains and concretions; neutral; gradual wavy boundary.

Bt1— 22 to 25 inches; brown (10YR 5/3) fine sandy loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films; common fine distinct very dark grayish brown (10YR 3/2) stains; neutral; clear smooth boundary.

2Bt2—25 to 30 inches; brown (10YR 5/3) silt loam; many medium distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles; moderate fine and medium subangular blocky structure; friable; few fine roots; thin patchy grayish brown (10YR 5/2) clay films; few fine distinct dark grayish brown (10YR 3/2) concretions; mildly alkaline; abrupt wavy boundary.

2Cg1—30 to 43 inches; light brownish gray (2.5Y 6/2) and pale brown (10YR 6/3) stratified very fine sand and silt; common fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few fine distinct very dark grayish brown (10YR 3/2) concretions; strong effervescence; moderately alkaline; abrupt smooth boundary.

2Cg2—43 to 60 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) stratified silt and very fine sand and a few bands of silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) and few fine faint pale brown (10YR 6/3) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 28 to 44 inches in thickness. The sandy material ranges from 20 to 35 inches in thickness. Reaction ranges from medium acid to neutral in the A, Bw, and Bt horizons, from slightly acid to mildly alkaline in the 2Bt horizon, and from neutral to moderately alkaline in the 2C horizon. The A, Bw, and Bt horizons are 0 to 5 percent gravel.

The Ap horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. Texture of the Bw horizon includes loamy fine sand and fine sand. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. It is fine sandy loam, loam, or sandy loam. The 2Bt horizon has color hue of 7.5YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silt loam or loam. The 2C horizon has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 1 to 6.

Blount Series

The Blount series consists of deep, somewhat poorly drained soils on ground moraines and end moraines. They formed in glacial till that is calcareous clay loam or silty clay loam. Permeability is moderately slow or slow. Slope ranges from 0 to 6 percent.

Blount soils are commonly adjacent to Glynwood, Pewamo, and Rimer soils and are similar to Del Rey, Fulton, and Nappanee soils. Glynwood soils are moderately well drained and are less gray in the subsoil than the Blount soils. Pewamo soils have a mollic epipedon and are very poorly drained. Rimer soils formed in sandy material 20 to 32 inches deep to fine or moderately fine textured materials. Del Rey and Fulton soils formed in lacustrine sediment and have fewer coarse fragments than the Blount soils. Nappanee soils have more clay directly below the surface horizon.

Typical pedon of Blount loam, 2 to 6 percent slopes, about 3 miles northwest of Fayette, in Gorham Township; about 2,227 feet south and 183 feet west of the northeast corner of sec. 14, T. 9 S., R. 1 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam; pale brown (10YR 6/3) dry; moderate fine granular structure; friable; few fine roots; few pebbles; slightly acid; abrupt smooth boundary.

Bt—10 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct strong brown (7.5YR 5/8) and dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; thin brown (10YR 5/3) silt coatings and thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); few pebbles; medium acid; clear wavy boundary.

Btg1—15 to 22 inches; dark grayish brown (10YR 4/2) clay loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few fine pores; thick patchy dark grayish brown (10YR 4/2) clay films on faces of peds; grayish brown (10YR 5/2) surfaces on peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); few pebbles; slightly acid; gradual wavy boundary.

Btg2—22 to 25 inches; dark grayish brown (10YR 4/2) clay loam; many fine distinct dark yellowish brown (10YR 4/4) and few fine distinct gray (10YR 6/1) mottles; moderate medium subangular blocky structure; firm; few fine roots; few fine pores; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); few pebbles; neutral; abrupt wavy boundary.

C—25 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse platy structure in upper 10 inches, massive; cleavage planes below a depth of 10 inches; grayish brown (10YR 5/2) and light gray (10YR 7/1) surface on cleavage planes; few fine pores; few fine black (10YR 2/1) concretions (iron and manganese oxides); strong effervescence; 5 percent pebbles; moderately alkaline.

The solum ranges from 20 to 36 inches in thickness. Carbonates range in depth from 19 to 36 inches. The solum is 0 to 5 percent coarse fragments, and the substratum is 1 to 10 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. Reaction ranges from strongly acid to slightly acid. In wooded areas, a 2- to 5-inch A horizon is present. This A horizon 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 6. It is clay loam, silty clay loam, silty clay, or clay. Reaction ranges from strongly acid to slightly acid in the upper part and medium acid to mildly alkaline in the lower part. In some pedons the lower part of the subsoil is moderately alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. Texture of the C horizon is clay loam or silty clay loam. Reaction is mildly alkaline or moderately alkaline.

Boyer Series

The Boyer series consists of deep, well drained soils on beach ridges and moraines. These soils formed in loamy and sandy, water-sorted materials. Permeability is moderately rapid in the solum and very rapid in the substratum. Slope ranges from 1 to 6 percent.

Boyer soils are commonly adjacent to Perrin and Gilford soils and are similar to Oshtemo and Spinks soils. Perrin soils are moderately well drained. Gilford soils have a mollic epipedon and are very poorly drained. Spinks soils have argillic horizons that consist of lamellae. Oshtemo soils have a thicker solum than Boyer soils.

Typical pedon of Boyer loamy sand, 1 to 6 percent slopes, about 0.5 mile north of Winameg, in Pike Township; about 2,604 feet north and 2,340 feet west of the southeast corner of sec. 4, T. 10 S., R. 3 E.

Ap—0 to 8 inches; dark brown (10YR 4/3) loamy sand; pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common fine roots; 5 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bw—8 to 17 inches; yellowish brown (10YR 5/6) loamy sand; common medium distinct light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; friable; few fine roots; few dark brown (7.5YR 4/4) discontinuous bands and nodules of sandy loam; 2 percent coarse fragments; medium acid; abrupt wavy boundary.

Bt1—17 to 20 inches; brown (7.5YR 5/4) sandy loam; weak medium subangular blocky structure; friable; thin very patchy dark brown (7.5YR 4/4) clay films on sand grains and clay bridges between sand grains; 3 percent coarse fragments; medium acid; gradual wavy boundary.

Bt2—20 to 30 inches; brown (7.5YR 5/4) coarse sandy loam; weak medium subangular blocky structure; friable; thin patchy reddish brown (5YR 4/4) clay films and clay coatings on sand grains; 5 percent coarse fragments; tongues, to a depth of 42 inches; slightly acid; abrupt irregular boundary.

2C—30 to 60 inches; pale brown (10YR 6/3) gravelly sand; single grained; loose; 25 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. The solum is 2 to 20 percent gravel, and the substratum is 10 to 40 percent gravel.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is medium acid to neutral. In wooded areas the A horizon is 1 to 3 inches thick. This A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. If present, the E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4.

The Bt horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 6. It is sandy loam, coarse sandy loam, or gravelly sandy loam. It is medium acid to mildly alkaline.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand, gravelly sand, or stratified sand and gravel. The C horizon is generally moderately alkaline, but in some pedons it is mildly alkaline.

Brady Series

The Brady series consists of deep, somewhat poorly drained soils on outwash plains, terraces, and beach ridges. Brady soils formed in loamy material 40 to 70 inches deep to stratified sandy and gravelly materials. Permeability is moderately rapid. The slope ranges from 0 to 3 percent.

When dry, the surface layer of this Brady soil is slightly lighter colored than is defined as the range of the Brady series. This difference does not alter the use or behavior of this soil.

Brady soils commonly are adjacent to Gilford, Millgrove, and Perrin soils and are similar to Digby, and Dixboro soils. Gilford and Millgrove soils have a mollic epipedon and are very poorly drained. Digby soils have more clay than the Brady soils. Perrin soils are moderately well drained. In Dixboro soils, stratified very fine sand and silt loam is within a depth of 40 inches.

Typical pedon of Brady sandy loam, 0 to 3 percent slopes, 2 miles east of Seward, in Amboy Township; 2,420 feet north and 1,075 feet east of the southwest corner of sec. 7, T. 9 S., R. 4 E.

Ap—0 to 8 inches; dark brown (10YR 3/3) sandy loam; pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few fine roots; 5 percent coarse fragments; 8 percent gravel at surface; medium acid; abrupt wavy boundary.

Bw1—8 to 13 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; few fine roots; 4 percent coarse fragments; medium acid; abrupt wavy boundary.

Bw2—13 to 19 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; 4 percent coarse fragments; medium acid; abrupt wavy boundary.

Bt1—19 to 26 inches; brown (7.5YR 4/4) sandy loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very friable; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; common medium distinct very dark brown (10YR 2/2) concretions (iron and manganese oxides); 6 percent coarse fragments; medium acid; gradual wavy boundary.

Bt2—26 to 34 inches; brown (7.5YR 4/4) sandy loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very friable; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; clay bridges between sand grains; common medium distinct very dark brown (10YR 2/2) concretions (iron and manganese oxides); 6 percent coarse fragments; medium acid; abrupt wavy boundary.

BC—34 to 60 inches; light brownish gray (2.5Y 6/2) and brown (7.5YR 4/4) loamy sand; common medium yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) mottles; single grained; loose; 2 percent coarse fragments; medium acid.

The solum is 40 to 62 inches thick. Free carbonates are at a depth of 42 to 70 inches. The solum is 2 to 15 percent gravel, and the substratum is 2 to 20 percent gravel.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 to 3. It is medium acid to neutral. In wooded areas, there is an A horizon 1 to 3 inches thick. This A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is loamy sand, sandy loam, sandy clay loam, or gravelly sandy loam. It is medium acid to neutral.

The 2B horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is loamy sand, sand, or stratified sand and gravel. Some pedons have clay loam till within 60 inches of the surface. The 2B horizon ranges from medium acid to neutral.

Cohoctah Series

The Cohoctah series consists of deep, very poorly drained soils. Cohoctah soils formed in loamy alluvium on flood plains. Permeability is moderately rapid. The slope is 0 to 2 percent.

Cohoctah soils commonly are adjacent to Shoals soils and are similar to Sloan soils. Shoals soils do not have a mollic epipedon and do not have dominantly low-chroma colors immediately below the surface horizon. They have a higher clay content than Cohoctah soils. Sloan soils have a higher clay content in the control section than Cohoctah soils.

Typical pedon of Cohoctah fine sandy loam, frequently flooded, about 3 miles northeast of Archbold, in German Township; 2,500 feet south and 50 feet west of the northeast corner of sec. 27, T. 7 N., R. 5 E.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam; grayish brown (10YR 5/2) dry; weak medium granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

Cg1—12 to 16 inches; grayish brown (10YR 5/2) fine sandy loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; many brown (10YR 5/3) organic stains; neutral; clear smooth boundary.

Cg2—16 to 33 inches; grayish brown (10YR 5/2) fine sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; massive; mildly alkaline; clear wavy boundary.

Cg3—33 to 60 inches; grayish brown (10YR 5/2) loamy fine sand; few fine distinct yellowish brown (10YR 5/4) mottles; single grained; friable; mildly alkaline.

In the Cohoctah soils, reaction ranges from slightly acid to mildly alkaline in the upper 20 inches and is mildly alkaline or moderately alkaline below a depth of 20 inches.

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 fine sandy loam or loamy fine sand.

The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. In some pedons this horizon contains thin layers that are high in organic matter. The Cg horizon has value of 3 to 6 and chroma of 1 to 3. It is loam, fine sandy loam, sandy loam, or loamy fine sand. In some pedons fine sand is below a depth of 40 inches.

Colwood Series

The Colwood series consists of deep, very poorly drained soils on outwash plains and deltas. These soils formed in stratified loamy material. Permeability is moderate. Slope is 0 to 2 percent.

Colwood soils are commonly adjacent to Bixler, Dixboro, Kibbie, and Tuscola soils and are similar to Mermill and Millgrove soils. Bixler soils consist of 20 to 35 inches of sandy material over stratified silty and sandy material. Dixboro soils have more sand than the Colwood soils and are brighter colored. Kibbie and Tuscola soils are brighter colored than the Colwood soils. Mermill soils have clayey material within 40 inches of the surface and do not have a mollic epipedon. Millgrove soils have an argillic horizon and have coarse fragments.

Typical pedon of Colwood loam, about 2.5 miles northwest of Tedrow, in Franklin Township; about 500 feet north and 500 feet west of the southeast corner of sec. 11, T. 10 S., R. 1 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam; dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

Bg1—10 to 14 inches; grayish brown (10YR 5/2) clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; slightly acid; clear smooth boundary.

Bg2—14 to 21 inches; gray (10YR 5/1) clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; neutral; gradual smooth boundary.

Bg3—21 to 25 inches; gray (10YR 5/1) clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; neutral; clear smooth boundary.

Bg4—25 to 31 inches; grayish brown (10YR 5/2) clay loam; common medium distinct dark brown (7.5YR 4/4) and yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; neutral; clear smooth boundary.

BCg—31 to 42 inches; gray (10YR 5/1) stratified silty clay loam and clay loam; common coarse distinct yellowish brown (10YR 5/4) weak mottles; coarse subangular blocky structure; firm; neutral; clear wavy boundary.

Cg—42 to 60 inches; dark grayish brown (2.5Y 4/2) stratified very fine sandy loam, silt loam, and silty clay loam; many medium distinct olive brown (2.5Y 4/4) and common fine distinct gray (10YR 5/1) mottles; massive; firm; weak effervescence; mildly alkaline.

The solum is 32 to 50 inches thick. Free carbonates are at a depth of 32 to 47 inches.

The A horizon is 10 to 18 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 or 5Y, value of 4 to 6, and chroma of 1 or 2. Some pedons have individual subhorizons that have hue of 10YR, value of 4 or 5, and chroma of 4 or 6. The B horizon is loam, sandy clay loam, silty clay loam, clay loam, and silt loam and has thin subhorizons of fine sand, very fine sand, and silty clay. It is slightly acid to mildly alkaline, but in some pedons it is moderately alkaline in the lower part.

The C horizon has hue of 10YR or 5Y, value of 4 to 6, and chroma of 1 or 2. It is stratified silt loam, very fine sand, fine sand, very fine sandy loam, and silty clay loam. In some pedons, it has thin strata of silty clay or silt. It is mildly alkaline or moderately alkaline.

Del Rey Series

The Del Rey series consists of deep, somewhat poorly drained soils on outwash plains and deltas. These soils formed in lacustrine deposits that are calcareous silt loam, silty clay loam, and silty clay. Permeability is slow. Slope ranges from 0 to 3 percent.

Del Rey soils are commonly adjacent to Lenawee soils and are similar to Blount, Fulton, Kibbie, and Nappanee soils. Lenawee soils are very poorly drained. Blount and Nappanee soils formed in glacial till and have more gravel than the Del Rey soils. Fulton soils have a higher clay content than Del Rey soils. The Fulton soils are underlain by silty clay and silty clay loam. Kibbie soils have a lower clay content in the subsoil than the Del Rey soils.

Typical pedon of Del Rey silt loam, 0 to 3 percent slopes, about 3 miles northwest of Archbold, in German Township; about 500 feet north and 280 feet west of the southeast corner of sec. 18, T. 7 N., R. 5 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam; pale brown (10YR 6/3) dry; weak coarse subangular blocky structure and weak medium granular structure; firm; few fine roots; few pieces of B horizon material; neutral; abrupt smooth boundary.

Bt—10 to 21 inches; light olive brown (2.5Y 5/4) silty clay loam; many fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine and medium subangular and angular blocky; firm; few fine roots; thin patchy grayish brown (10YR 5/2) clay films; few fine pores; slightly acid; gradual wavy boundary.

Btg1—21 to 27 inches; grayish brown (10YR 5/2) silty clay loam; moderate medium distinct dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to strong medium angular blocky; firm; few fine roots; few fine pores; thin continuous grayish brown (10YR 5/2) clay films; neutral; clear wavy boundary.

Btg2—27 to 34 inches; grayish brown (10YR 5/2) silty clay loam; moderate medium distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse prismatic structure parting to moderate medium and coarse angular blocky; firm; thin patchy grayish brown (10YR 5/2) clay films; few fine pores; neutral; clear wavy boundary.

BCg— 34 to 41 inches; gray (10YR 5/1) silty clay loam; many coarse distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse angular blocky structure; firm; few fine roots; few fine pores; gray (10YR 6/1) faces of peds; slight effervescence; moderately alkaline; clear wavy boundary.

Cg—41 to 60 inches; gray (10YR 6/1) and dark yellowish brown (10YR 4/4) stratified silty clay loam and silt loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 22 to 44 inches in thickness. Reaction in the solum ranges from medium acid to neutral in the upper part and from neutral to moderately alkaline in the lower part.

The Ap horizon has value of 4 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 to 6. It is dominantly silty clay loam or silty clay, but thin subhorizons of silt loam are common.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is silt loam and silty clay loam with thin strata of silty clay and fine sandy loam.

Digby Series

The Digby series consists of deep, somewhat poorly drained soils on outwash plains and beach ridges. These soils formed in loamy material over loamy, sandy, and gravelly materials deposited by water. Permeability is moderate in the solum and rapid in the substratum. Slope is 0 to 3 percent.

Digby soils are commonly adjacent to Perrin and Millgrove soils and are similar to Haskins, Kibbie, and Brady soils. Perrin soils are moderately well drained and have less clay than Digby soils. Millgrove soils have a mollic epipedon and are very poorly drained. Haskins soils have clayey material within a depth of 40 inches. Kibbie soils have more silt and less gravel than Digby soils and are underlain by stratified very fine sandy and silty materials. Brady soils have less clay in the control section.

Typical pedon of Digby loam, 0 to 3 percent slopes, about 3 miles southeast of Archbold, in German Township; about 300 feet south and 2,375 feet east of the northwest corner of sec. 12, T. 7 N., R. 5 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam; light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; few fine roots; 10 percent coarse fragments; common dark yellowish brown (10YR 4/4) chunks of material from the B horizon; medium acid; abrupt smooth boundary.

Bt1—10 to 22 inches; dark yellowish brown (10YR 4/4) clay loam and a few pockets of sandy loam; dark grayish brown (10YR 4/2) faces of peds; common fine distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films; clay bridges between sand grains; 10 percent coarse fragments; slightly acid; gradual wavy boundary.

Bt2—22 to 27 inches; dark yellowish brown (10YR 4/4) clay loam and a few pockets of sandy loam; dark grayish brown (10YR 4/2) faces of peds; many fine and medium distinct dark grayish brown (10YR 4/2) and grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; thin very patchy dark grayish brown (10YR 4/2) clay films; 10 percent coarse fragments; neutral; clear wavy boundary.

2BC—27 to 32 inches; yellowish brown (10YR 5/4) sandy loam; many medium distinct grayish brown (2.5Y 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure; friable; weak effervescence; 10 percent coarse fragments; mildly alkaline; clear wavy boundary.

2Cg—32 to 60 inches; dark grayish brown (10YR 4/2) gravelly loamy coarse sand; single grained; loose; strong effervescence; 15 percent coarse fragments; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 42 inches. The solum is 2 to 15 percent gravel, and the substratum is 15 to 40 percent gravel.

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 A horizon 1 to 4 inches thick. This A horizon 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 2 to 4. It is loam, sandy clay loam, and clay loam. In some pedons it has thin subhorizons of sandy loam. Reaction in the B horizon is strongly acid to slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is gravelly loamy sand, gravelly loamy coarse sand, or gravelly sandy loam and thin subhorizons of loamy sand, loamy coarse sand, or sandy loam. It is commonly moderately alkaline; but in some pedons it is mildly alkaline.

Dixboro Series

The Dixboro series consists of deep, somewhat poorly drained soils on outwash plains and deltas. These soils formed in stratified silty and loamy materials. Permeability is moderate. Slope is 0 to 3 percent.

Dixboro soils are commonly adjacent to Colwood and Lamson soils and are similar to Kibbie and Brady soils. Lamson soils are very poorly drained. Colwood soils have a mollic epipedon and are very poorly drained. Kibbie soils have a higher clay content than Dixboro soils. Brady soils have coarser sand and have gravel in the solum and substratum.

Typical pedon of Dixboro fine sandy loam, 0 to 3 percent slopes, about 2.5 miles northeast of Tedrow, in Chesterfield Township; about 520 feet north and 800 feet west of the southeast corner of sec. 32, T. 9 S., R. 2 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) fine sandy loam; brown (10YR 5/3) dry; weak fine granular structure; very friable; common medium roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 16 inches; yellowish brown (10YR 5/4) fine sandy loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; few fine pores; thin very patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; gradual wavy boundary.

Bt2—16 to 20 inches; yellowish brown (10YR 5/4) loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; few fine pores; thin very patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; slightly acid; clear wavy boundary.

Bt3—20 to 26 inches; dark yellowish brown (10YR 4/4) fine sandy loam; common fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; few fine pores; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; slightly acid; clear wavy boundary.

Bt4—26 to 36 inches; dark yellowish brown (10YR 4/4) fine sandy loam; few fine faint yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; few fine roots; few fine pores; thick patchy dark yellowish brown (10YR 4/4) clay films on faces of peds and clay bridges between sand grains; neutral; abrupt wavy boundary.

BC—36 to 39 inches; brown (10YR 4/3) silt loam; many medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) and few fine distinct light gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine pores; common fine distinct black (10YR 2/1) stains; neutral; abrupt wavy boundary.

C—39 to 60 inches; brown (10YR 5/3) stratified very fine sandy loam and silt loam; many medium distinct gray (10YR 5/1) and few fine faint light gray (10YR 7/1) mottles; massive; friable; common fine distinct black (10YR 2/1) stains; strong effervescence; moderately alkaline.

The solum ranges from 24 to 44 inches in thickness. Free carbonates range from a depth of 20 to 40 inches. The solum is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3.

The B horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. It is very fine sandy loam, fine sandy loam, loam, or silt loam and thin subhorizons of loamy very fine sand.

The C horizon has hue of 10YR, value of 4 to 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 silty clay and silty clay loam.

Eel Series

The Eel series consists of deep, moderately well drained soils on flood plains. These soils formed in loamy alluvium. Permeability is moderate. Slope is 0 to 2 percent.

Eel soils are commonly adjacent to Shoals and Sloan soils. Shoals soils are somewhat poorly drained. Sloan soils have a mollic epipedon and are very poorly drained.

Typical pedon of Eel silt loam, frequently flooded, about 1.5 miles northwest of Elmira, in Franklin Township; about 2,221 feet south and 215 feet west of the northeast corner of sec. 6, T. 7 N., R. 5 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; few fine roots; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; abrupt smooth boundary.

C1—10 to 19 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; few fine roots; dark brown (7.5YR 4/4) faces of peds; very patchy dark grayish brown (10YR 4/2) organic coatings on faces of peds; neutral; abrupt wavy boundary.

C2—19 to 27 inches; dark yellowish brown (10YR 4/4) silt loam; common medium distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; friable; few fine roots; patchy dark grayish brown (10YR 4/2) organic coatings on faces of peds; common fine distinct very dark brown (10YR 2/2) concretions (iron and manganese oxides); neutral; gradual wavy boundary.

C3—27 to 34 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; many fine and medium distinct very dark brown (10YR 2/2) concretions (iron and manganese oxides); neutral; gradual wavy boundary.

Cg1—34 to 41 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium distinct gray (10YR 5/1) and dark yellowish brown (10YR 4/4) mottles; massive; friable; common fine and medium distinct very dark brown (10YR 2/2) concretions (iron and manganese oxides); neutral; gradual wavy boundary.

Cg2—41 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium distinct grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 4/4) mottles; massive; firm; common medium very dark brown (10YR 2/2) concretions (iron and manganese oxides); neutral.

Free carbonates commonly are at a depth of 34 to 68 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. In undisturbed areas the soil has an A horizon 1 inch to 6 inches thick. This A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3. Reaction of the A horizon is slightly acid or neutral.

The upper part of the C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 4. Mottles that have chroma of 2 or less are within the upper 20 inches. Texture is dominantly silt loam or loam, but individual subhorizons range from sandy loam to silty clay loam in places. Reaction ranges from slightly acid to mildly alkaline.

The lower part of the C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It commonly ranges from sandy loam to silty clay loam but has strata of sandy and gravelly material. Reaction ranges from neutral to moderately alkaline.

Fulton Series

The Fulton series consists of deep, somewhat poorly drained soils on lake plains and deltas. These soils formed in clayey, lake sediment. Permeability is slow or very slow. Slope ranges from 0 to 6 percent.

Fulton soils are commonly adjacent to Latty and Shinrock soils and are similar to the Blount, Del Rey, Haskins, and Nappanee soils. Latty soils are very poorly drained. Shinrock soils are moderately well drained and have less clay in the substratum than Fulton soils. Blount and Nappanee soils formed in glacial till and have coarse fragments. Del Rey soils have less clay in the subsoil and are over stratified silt loam and silty clay loam. Haskins soils have more sand in the upper part of the solum than the Fulton soils.

Typical pedon of Fulton silty clay loam, 0 to 2 percent slopes, about 1 mile west of Burlington, in German Township; about 1,880 feet north and 60 feet east of the southwest corner of sec. 8, T. 7 N., R. 5 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam; pale brown (10YR 6/3) dry; moderate medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; common grayish brown (10YR 5/2) coatings on faces of peds; thin patchy clay films; neutral; abrupt wavy boundary.

Bt2—15 to 24 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure parting to moderate fine angular blocky; very firm; few fine roots; common grayish brown (2.5Y 5/2) coatings on faces of peds; thin patchy clay films on faces of peds; neutral; gradual wavy boundary.

Bt3—24 to 28 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct dark grayish brown (10YR 4/2) mottles; moderate medium angular blocky structure; very firm; few medium roots; common grayish brown (2.5Y 5/2) coatings on faces of peds; thin patchy clay films on faces of peds; mildly alkaline; gradual wavy boundary.

C—28 to 60 inches; dark yellowish brown (10YR 4/4) stratified silty clay and silty clay loam; common medium distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; massive but parts along horizontal cleavage planes because of stratification; very firm; gray (5Y 5/1) streaks along cleavage planes and light gray (10YR 7/2) lime stains on cleavage planes; strong effervescence; moderately alkaline.

The solum ranges from 24 to 39 inches in thickness. Carbonates range in depth from 22 to 36 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. In wooded areas the A horizon is 2 to 4 inches thick. This A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 or 2. It is silty clay loam or loam. The reaction of the A horizon ranges from medium acid to neutral.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 through 4. It is silty clay loam, silty clay, or clay. The reaction of the B horizon is medium acid to mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is silty clay, clay, or silty clay loam, but in places it has thin strata of silt loam and very fine sand.

Galen Series

The Galen series consists of deep, moderately well drained soils on beach ridges, sand dunes, and moraines. These soils formed in sandy material. Permeability is moderate or moderately rapid. Slope ranges from 1 to 6 percent.

Galen soils are commonly adjacent to Granby and Spinks soils and are similar to Ottokee soils. Granby soils have a mollic epipedon and are very poorly drained. Spinks soils have lamellae of loamy fine sand. Ottokee soils do not have an argillic horizon.

Typical pedon of Galen loamy fine sand, 1 to 6 percent slopes, about 6 miles southeast of Delta, in Swan Creek Township; about 1,720 feet south and 400 feet east of the northwest corner of sec. 9, T. 6 N., R. 8 E.

Ap— 0 to 10 inches; brown (10YR 4/3) loamy fine sand; pale brown (10YR 6/3) dry; weak, fine granular structure; very friable; few fine roots; slightly acid; abrupt smooth boundary.

Bw—10 to 28 inches; light yellowish brown (10YR 6/4) loamy fine sand° few medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few fine roots; slightly acid; abrupt wavy boundary.

E/B—28 to 38 inches; dark yellowish brown (10YR 4/4) loamy fine sand (E); single grained; loose; intermixed with dark brown (10YR 4/3) fine sandy loam (Bt); weak medium subangular blocky structure; friable; few fine roots; slightly acid; abrupt wavy boundary.

Bt—38 to 42 inches; dark brown (7.5YR 4/4) fine sandy loam; common medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common bridges of clay between sand grains and patchy brown (10YR 4/4) clay films in pores; slightly acid; gradual wavy boundary.

BC—42 to 58 inches; dark brown (7.5YR 4/4) loamy fine sand; common medium distinct light gray (10YR 7/2) and grayish brown (10YR 5/2) mottles; single grained; loose; slightly acid; abrupt wavy boundary.

C—58 to 68 inches; yellowish brown (10YR 5/4) fine sand; common medium faint grayish brown (10YR 5/2) mottles; single grained; loose; slightly acid.

The solum ranges from 40 to 64 inches in thickness. Carbonates are at a depth of more than 48 inches. Gravel content of the solum ranges from 0 to 3 percent.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral. In wooded areas, there is an A horizon 2 to 5 inches thick. This A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 6. It is fine sand, loamy fine sand, or sand. The reaction of the Bw horizon ranges from medium acid to neutral.

The E part of the E/B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. The texture is fine sand or loamy fine sand. The B part has hue of 5YR to 10YR, value of 3 or 4, and chroma of 3 or 4. The B texture is fine sandy loam or very fine sandy loam, but thin lamellae of loamy fine sand or loamy very fine sand are in some pedons. Reaction of the E/B horizon ranges from medium acid to neutral.

Where present, the BC horizon has hue of 5YR to 10YR, value of 3 or 4, and chroma of 3 or 4. It is fine sand or loamy fine sand. The reaction of the BC horizon ranges from medium acid to neutral.

The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is fine sand, very fine sand, loamy fine sand, or loamy very fine sand. The reaction of the C horizon is slightly acid to mildly alkaline.

Gilford Series

The Gilford series consists of deep, very poorly drained soils on outwash plains, beach ridges, and deltas. These soils formed in sandy material. Permeability is moderately rapid. Slope is 0 to 2 percent.

Gilford soils are commonly adjacent to Boyer, Brady, and Oshtemo soils and are similar to Granby soils. Boyer and Oshtemo soils are well drained. Boyer, Oshtemo, and Brady soils do not have a mollic epipedon. Brady soils are somewhat poorly drained. Granby soils have more sand in the control section than Gilford soils.

Typical pedon of Gilford fine sand loam, about 3 miles west of Oakshade, in Chesterfield Township; about 960 feet south and 117 feet west of the northeast corner of sec. 30, T. 9 S., R. 2 E.

Ap—0 to 11 inches; black (10YR 2/1) fine sandy loam; dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bg1—11 to 14 inches; dark gray (10YR 4/1) fine sandy loam; common medium distinct dark grayish brown (2.5Y 4/2) mottles; weak medium subangular blocky structure; friable; few fine roots; common medium distinct very dark gray (10YR 3/1) organic stains; 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bg2—14 to 25 inches; grayish brown (2.5Y 5/2) sandy loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; few medium distinct very dark gray (10YR 3/1) organic stains; 3 percent coarse fragments; neutral; gradual wavy boundary.

Bg3—25 to 31 inches; grayish brown (2.5Y 5/2) sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few medium distinct very dark gray (10YR 3/1) organic stains; 5 percent coarse fragments; neutral; abrupt smooth boundary.

Cg—31 to 60 inches; grayish brown (2.5Y 5/2) loamy sand; few medium distinct dark yellowish brown (10YR 4/4) mottles; single grained; loose; thin strata of gravelly sand; strong effervescence; mildly alkaline.

The solum ranges from 26 to 40 inches in thickness. The mollic epipedon ranges from 10 to 15 inches in thickness. Carbonates are at a depth of 30 to 46 inches. The solum is 0 to 5 percent coarse fragments, and the substratum is 0 to 15 percent coarse fragments.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction of the A horizon is slightly acid or neutral.

The B horizon has hue of 10YR or 5Y, value of 4 to 6, and chroma of 1 or 2. It is commonly fine sandy loam or sandy loam, but in places individual subhorizons range from loamy sand to light clay loam. Reaction of the B horizon is slightly acid or neutral.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 3. It is fine sand, sand, loamy sand, or loamy fine sand. Thin strata of sandy loam or gravelly sand are in some pedons.

Glynwood Series

The Glynwood series consists of deep, moderately well drained soils on till plains and moraines. These soils formed in till of calcareous clay loam or silty clay loam. Permeability is slow. Slope ranges from 2 to 18 percent.

Glynwood soils are commonly adjacent to Blount, Pewamo, and Ottokee soils and are similar to Shinrock soils. Blount soils are somewhat poorly drained. Pewamo soils have a mollic epipedon and are very poorly drained. Ottokee soils formed in fine sand. Shinrock soils formed in lacustrine sediment. They have fewer coarse fragments than the Glynwood soils.

Typical pedon of Glynwood loam, 2 to 6 percent slopes, eroded, about 3.5 miles southwest of Fayette, in Gorham Township; 2,050 feet south and 125 feet east of the northwest corner of sec. 35, T. 9 S., R. 1 W.

Ap—0 to 8 inches; brown (10YR 4/3) loam mixed with some clay loam; light brownish gray (10YR 6/2) dry; weak fine granular structure and weak fine subangular blocky structure; friable; many fine roots; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt1—8 to 15 inches; dark yellowish brown (10YR 4/4) clay; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; thin very patchy dark grayish brown (10YR 4/2) and patchy brown (10YR 5/3) clay films; common fine black (10YR 2/1) stains; 3 percent coarse fragments; slightly acid; gradual wavy boundary.

Bt2—15 to 20 inches; dark yellowish brown (10YR 4/4) clay; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; thin patchy brown (10YR 4/3) clay films; common fine very dark gray (10YR 3/1) stains; 3 percent coarse fragments; neutral; clear wavy boundary.

Bt3—20 to 27 inches; brown (10YR 4/3) clay loam; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; firm; few fine roots; thin very patchy grayish brown (10YR 5/2) clay films; few light gray (10YR 7/2) lime coatings; 3 percent coarse fragments; weak effervescence; moderately alkaline; clear wavy boundary.

C—27 to 60 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; massive; firm; few fine roots; few light gray (10YR 6/1) lime coatings; 3 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 18 to 36 inches in thickness. Carbonates range in depth from 16 to 36 inches. The solum is 0 to 5 percent coarse fragments, and the substratum is 1 to 10 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Reaction ranges from medium acid to neutral. In wooded areas, there is an A horizon 1 inch to 4 inches thick. This A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. Chroma of 2 is not dominant in the upper 10 inches of the argillic horizon. The Bt horizon is silty clay or clay and thin subhorizons of clay loam. Reaction of the B horizon ranges from strongly acid to neutral in the upper part and medium acid to moderately alkaline in the lower part.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is clay loam or silty clay loam.

Granby Series

The Granby series consists of deep, very poorly drained soils on outwash plains and lake plains. These soils formed in sandy material. Permeability is rapid. Slope is 0 to 2 percent.

Granby soils are commonly adjacent to Galen, Oakville, Ottokee, Spinks, and Tedrow soils and are similar to Gilford soils. Galen and Spinks soils have an argillic horizon. Galen, Spinks, Oakville, and Ottokee soils are brighter colored than Granby soils. Oakville and Ottokee soils do not have a mollic epipedon. Tedrow soils are less gray than Granby soils and do not have a mollic epipedon. Gilford soils have a higher clay content.

Typical pedon of Granby loamy fine sand, about 6 miles southeast of Delta, in Swan Creek Township; about 55 feet south and 1,100 feet west of the northeast corner of sec. 4, T. 6 N., R. 8 E.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand; dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine roots; neutral; abrupt smooth boundary.

ABg—10 to 18 inches; very dark grayish brown (10YR 3/2) loamy fine sand; light brownish gray (6/2) dry; common medium distinct light brownish gray (10YR 6/2) and olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; very friable; common fine roots; common medium distinct black (10YR 2/1) organic stains; neutral; gradual wavy boundary.

Bg—18 to 24 inches; gray (5Y 5/1) fine sand; common medium distinct yellowish brown (10YR 5/6) and few medium distinct greenish gray (5G 6/1) mottles; weak medium subangular blocky structure; very friable; few fine roots; neutral; clear smooth boundary.

BCg—24 to 36 inches; dark gray (5Y 4/1) fine sand; common medium distinct olive brown (2.5Y 4/4) mottles; single grained; loose; neutral; abrupt smooth boundary.

Cg—36 to 51 inches; grayish brown (2.5Y 5/2) fine sand; common medium distinct olive brown (2.5Y 4/4) mottles; single grained; loose; neutral; abrupt smooth boundary.

C—51 to 60 inches; olive brown (2.5Y 4/4) fine sand; common medium distinct grayish brown (2.5Y 5/2) mottles; single grained; loose; neutral.

The solum ranges from 26 to 50 inches in thickness. The mollic epipedon ranges from 10 to 15 inches in thickness. Carbonates range in depth from 32 to 65 inches. In some pedons the soil is 1 to 5 percent coarse fragments.

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 to 5Y, value of 4 to 6, and chroma of 1 or 2. It is sand, fine sand, or loamy fine sand. Reaction in the B horizon ranges from medium acid to mildly alkaline. In some pedons thin bands of sandy loam are in the lower part of the B horizon or in the C horizon.

The C horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 to 4. It is sand or fine sand. The reaction of the C horizon ranges from neutral to moderately alkaline.

Haskins Series

The Haskins series consists of deep, somewhat poorly drained soils on outwash plains, terraces, and beach ridges. These soils formed in loamy material that is 20 to 40 inches deep to moderately fine and fine textured till or lacustrine material. Permeability is moderate in the loamy material and slow or very slow in the substratum. Slope is 0 to 3 percent.

Haskins soils are commonly adjacent to Rawson and Mermill soils and are similar to Digby, Fulton, and Nappanee soils. Rawson soils are better drained than Haskins soils. They have less gray in the subsoil than the Haskins soils. Mermill soils have a darker colored surface layer and are very poorly drained. Digby soils do not have fine textured material within a depth of 40 inches. Fulton and Nappanee soils have more clay in the subsoil.

Typical pedon of Haskins loam, 0 to 3 percent slopes, about 2 miles southeast of Pettisville, in Clinton Township; about 395 feet north and 2,400 feet west of the southeast corner of sec. 5, T. 7 N., R. 6 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; few fine roots; few coarse fragments; neutral; abrupt smooth boundary.

Bt1—9 to 16 inches; dark yellowish brown (10YR 4/4) sandy clay loam; grayish brown (10YR 5/2) faces of peds; common medium distinct grayish brown (10YR 5/2) and few fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; neutral; clear wavy boundary.

Bt2—16 to 25 inches; dark yellowish brown (10YR 4/4) sandy clay loam; grayish brown (10YR 5/2) faces of peds; many medium distinct grayish brown (10YR 5/2) mottles; weak medium and fine subangular structure; friable; few fine roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; neutral; abrupt wavy boundary.

2Btg—25 to 32 inches; grayish brown (2.5Y 5/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; thin very patchy grayish brown (10YR 5/2) clay films; slight effervescence; 4 percent coarse fragments; mildly alkaline; diffuse wavy boundary.

2Cg—32 to 60 inches; grayish brown (2.5Y 5/2) clay loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; very firm; strong effervescence; 4 percent coarse fragments; moderately alkaline.

The solum ranges from 25 to 45 inches in thickness, and, typically, it extends into the underlying fine textured material. The upper part of the solum is 2 to 10 percent coarse fragments. The lower part of the solum and the underlying fine and moderately fine textured material is 0 to 8 percent coarse fragments.

The A horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is sandy loam or loam. Reaction of the A horizon ranges from 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, sandy clay loam, or clay loam. Reaction of the B horizon ranges from strongly acid to neutral in the upper part and from slightly acid to mildly alkaline in the lower part. The 2B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 0 to 3. It is clay, clay loam, or silty clay. Reaction ranges from neutral to moderately alkaline.

The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 3. It is clay loam, clay, or silty clay.

Hoytville Series

The Hoytville series consists of deep, very poorly drained soils on lake plains. These soils formed in glacial till modified by water action. Permeability is moderately slow in the subsoil and slow in the substratum. Slope ranges from 0 to 2 percent.

Hoytville soils are commonly adjacent to Nappanee and Glynwood soils and are similar to Latty, Lenawee, and Pewamo soils. Nappanee soils are less gray in the subsoil and have a lighter colored surface layer than Hoytville soils. Glynwood soils have a light colored surface layer and are not dominated by gray in the subsoil. Latty soils have a lighter colored surface layer and do not have coarse fragments. Lenawee soils have less clay and do not have coarse fragments. Pewamo soils have a mollic epipedon and less clay in the substratum than Hoytville soils.

Typical pedon of Hoytville clay loam, about 5 miles southeast of Wauseon, in York Township; about 70 feet north and 1,775 feet east of the southwest corner of sec. 7, R. 7 E., T. 6 N.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) clay loam; grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; few fine roots; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

Btg1—8 to 19 inches; grayish brown (2.5Y 5/2) clay; common fine distinct strong brown (7.5YR 5/6) and dark yellowish brown (10YR 4/4) mottles; moderate fine subangular and angular blocky structure; firm; few fine roots; few fine pores; thin patchy very dark gray (10YR 3/1) organic coatings; thin patchy gray (N 5/) clay films on faces of peds; few fine black (10YR 2/1) stains (iron and manganese oxides); slightly acid; 2 percent coarse fragments; gradual wavy boundary.

Btg2—19 to 29 inches; grayish brown (2.5Y 5/2) clay; common medium distinct dark yellowish brown

(10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine pores; few fine roots; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few fine black (10YR 2/1) stains (iron and manganese oxides); 2 percent coarse fragments; slightly acid; clear wavy boundary.

BCg—29 to 38 inches; grayish brown (2.5Y 5/2) clay loam; many coarse distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; firm; few fine pores; 2 percent coarse fragments; neutral; abrupt wavy boundary.

Cg—38 to 60 inches; grayish brown (2.5Y 5/2) clay loam; many coarse distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and depth to free carbonates range from 36 to 55 inches. The solum and substratum are 1 to 10 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is clay loam or loam. It is slightly acid or neutral. In wooded areas, there is an A horizon 2 to 5 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The Bt horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay or silty clay. Reaction in the Bt horizon is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is clay or clay loam.

Kibbie Series

The Kibbie series consists of deep, somewhat poorly drained soils on outwash plains and deltas. These soils formed in stratified silt, fine sand, and very fine sand. Permeability is moderate. Slope ranges from 0 to 3 percent.

When it is dry, the surface layer of the Kibbie soil is slightly lighter colored than is defined as the range of the Kibbie series. This difference does not alter the use or behavior of this soil.

Kibbie soils are commonly adjacent to Colwood and Tuscola soils and are similar to Del Rey, Digby, and Dixboro soils. Colwood soils have a mollic epipedon and are very poorly drained. Tuscola soils are better drained and have less gray in the subsoil than the Kibbie soils. Del Rey soils have a higher clay content in the argillic horizon. Digby soils have more gravel than Kibbie soils and are underlain by sandy and gravelly deposits. Dixboro soils have a mollic surface soil and have more sand in the argillic horizon than Kibbie soils.

Typical pedon of Kibbie loam, 0 to 3 percent slopes, about 1 mile east of Burlington, in German Township; about 85 feet north and 907 feet west of the southeast corner of sec. 9, T. 7 N., R. 5 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loam; light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—10 to 19 inches; dark brown (10YR 4/3) loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; friable; common fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—19 to 26 inches; dark brown (10YR 4/3) loam; common medium distinct yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds and in old root channels; neutral; gradual wavy boundary.

Bt3—26 to 32 inches; brown (10YR 5/3) silt loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; weak effervescence in places; mildly alkaline; abrupt wavy boundary.

C—32 to 60 inches; brown (10YR 5/3) stratified silt loam, fine sand, and silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; massive; friable; common medium distinct light gray (10YR 7/2) lime accumulations; few fine distinct very dark gray (10YR 3/1) accumulations (iron and manganese oxides); strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 48 inches. The solum is 0 to 5 percent coarse fragments, but the substratum is free of coarse fragments.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It ranges from medium acid to neutral. In wooded areas, there is an A horizon 2 to 5 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. When the soil is dry, value is 5 or less. This A horizon is very fine sandy loam, loam, or silt loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is loam, silt loam, clay loam, or silty clay loam. Reaction in the Bt horizon ranges from medium acid to neutral in the upper part and from slightly acid to neutral in the lower part.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is stratified silt loam, very fine sand, fine sand, loamy very fine sand, and silty clay loam. Thin strata of silty clay loam or silt is in some pedons. The C horizon is mildly alkaline or moderately alkaline.

Lamson Series

The Lamson series consists of deep, very poorly drained soils on lake plains. These soils formed in loamy and sandy material deposited by water. Permeability is moderate. Slope is 0 to 2 percent.

Lamson soils are commonly adjacent to Bixler and Dixboro soils and are similar to Wauseon soils. Bixler soils are more sandy than Lamson soils and have a brighter colored subsoil. Dixboro soils have an argillic horizon and are somewhat poorly drained. Wauseon soils have a mollic epipedon and are underlain by fine or moderately fine textured material.

Typical pedon of Lamson fine sandy loam, about 2 miles north of Tedrow, in Dover Township; about 1,675 feet south and 55 feet west of the northeast corner of sec. 6, T. 10 S., R. 2 E.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam; gray (10YR 4/1) dry; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bw—9 to 18 inches; brown (10YR 4/3) fine sandy loam; many medium faint dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; friable; common fine roots; many fine and medium very dark brown (10YR 2/2) accumulations (iron and manganese oxides); neutral; abrupt wavy boundary.

Bg—18 to 30 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; few fine roots; common fine and medium very dark brown (10YR 2/2) accumulations (iron and manganese oxides); neutral; abrupt smooth boundary.

Cg1—30 to 35 inches; gray (5Y 5/1) silt loam; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; massive parting to weak medium platy structure; friable; mildly alkaline; abrupt wavy boundary.

Cg2—35 to 46 inches; grayish brown (2.5Y 5/2) very fine sand and silt loam; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; massive parting to weak thin platy structure; friable; mildly alkaline; abrupt smooth boundary.

Cg3—46 to 60 inches; dark grayish brown (2.5Y 4/2) very fine sand and silt; common medium distinct dark yellowish brown (10YR 4/4) and gray (N 5/0) mottles; massive; friable; strong effervescence; mildly alkaline.

The solum is 30 to 48 inches thick. Free carbonates are at a depth of 32 to 54 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is medium acid to neutral. In wooded areas there is an A horizon 2 to 5 inches thick.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. 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. It is medium acid to neutral in the upper part and slightly acid or neutral in the lower part.

The C horizon has hue of 10YR to 5Y or is neutral, value of 4 to 6, and chroma of 0 to 4. It is stratified fine sand, very fine sand, silt, and silt loam, and very fine sandy loam. The C horizon is neutral to moderately alkaline.

Latty Series

The Latty series consists of deep, very poorly drained soils on lake plains. These soils formed in clayey, lacustrine sediment. Permeability is slow in the subsoil and very slow in the substratum. Slope is 0 to 2 percent.

Latty soils are commonly adjacent to Fulton soils and are similar to Hoytville and Lenawee soils. Fulton soils are not dominantly gray in at least one subhorizon in the subsoil. Hoytville soils have a darker surface layer and have some coarse fragments. Lenawee soils have less clay than the Latty soils and are underlain by stratified silt loam and silty clay loam.

Typical pedon of Latty silty clay, in Archbold, in German Township; about 150 feet south and 1,860 feet east of the northwest corner of sec. 4, T. 6 N., R. 5 E.

Ap—0 to 9 inches; dark gray (10YR 4/1) silty clay; light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; firm; many fine roots; common medium distinct very dark gray (10YR 3/1) organic stains; neutral; abrupt smooth boundary.

Bg1—9 to 16 inches; dark gray (10YR 4/1) clay; common medium distinct strong brown (7.5YR 5/6) and dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky structure; firm; many fine roots; neutral; clear smooth boundary.

Bg2—16 to 26 inches; gray (10YR 5/1) clay; common medium distinct yellowish brown (10YR 5/4 & 5/6) mottles; weak medium prismatic structure parting to moderate fine angular blocky; firm; few fine roots; few dark gray (10YR 4/1) organic stains; few fine distinct very dark grayish brown (10YR 3/2) concretions; neutral; clear wavy boundary.

Bg3—26 to 44 inches; gray (10YR 5/1) clay; common medium distinct yellowish brown (10YR 5/4 & 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; few dark gray (10YR 4/1) organic stains; few fine distinct very dark grayish brown (10YR 3/2) concretions; mildly alkaline; clear wavy boundary.

BCg—44 to 52 inches; gray (10YR 5/1) clay; many coarse distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; weak effervescence; mildly alkaline; clear wavy boundary.

Cg—52 to 60 inches; gray (10YR 5/1) clay; many medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; few fine distinct very dark gray (10YR 3/1) concretions; few medium distinct light gray (10YR 7/1) lime concretions; weak effervescence; moderately alkaline.

The solum ranges from 34 to 55 inches in thickness. Carbonates range in depth from 34 to 50 inches.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 1 or 2. It is slightly acid or neutral. In wooded areas, there is an A horizon 3 to 5 inches thick. It 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. Reaction of the B horizon ranges from slightly acid 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 has strata of silty clay loam or clay loam. Some pedons have a 2C horizon that is glacial till of clay or clay loam.

Lenawee Series

The Lenawee series consists of deep, very poorly drained soils on lake plains. These soils formed in clayey and silty lacustrine deposits underlain by stratified silt loam, silty clay loam, and very fine sand. Permeability is moderately slow. Slope is 0 to 2 percent.

In this survey area, the surface layer of the Lenawee soil is slightly lighter colored than is defined as the range of the Lenawee series. This difference does not alter the use or behavior of the soil.

Lenawee soils are commonly adjacent to Del Rey and Shinrock soils and are similar to Hoytville and Latty soils. Del Rey and Shinrock soils have fewer low chroma colors in the subsoil than Lenawee soils. Hoytville soils have coarse fragments and formed in glacial till. Latty soils have more clay than Lenawee soils.

Typical pedon of Lenawee silty clay loam, about 3 miles west of Archbold, in German Township; about 250 feet north and 700 feet west of the southeast corner of sec. 35, T. 7 N., R. 5 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam; light brownish gray (10YR 6/2) dry; weak fine subangular structure and weak coarse granular structure; firm; neutral; abrupt smooth boundary.

Bg1—9 to 15 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; firm; few fine pores; few fine black (10YR 2/1) concretions; neutral; gradual wavy boundary.

Bg2—15 to 24 inches; gray (5Y 6/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine pores; few fine black (10YR 2/1) concretions; neutral; gradual wavy boundary.

Bg3—24 to 35 inches; gray (5Y 6/1) silty clay loam; many coarse distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine pores; few fine black (10YR 2/1) concretions; mildly alkaline; clear wavy boundary.

Cg—35 to 60 inches; gray (5Y 6/1) and dark yellowish brown (10YR 4/4) silty clay loam; massive; very firm; light gray (10YR 6/1) lime coatings along cleavage planes; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 25 to 50 inches.

The A horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is silty clay loam or loam. Reaction in the A horizon 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 silty clay, silty clay loam, or clay loam. Reaction of the B horizon ranges from slightly acid to mildly alkaline.

The C horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 4. It is dominantly stratified silt loam, silty clay loam, and very fine sand.

Mermill Series

The Mermill series consist of deep, very poorly drained soils on outwash plains, terraces, and beach ridges. These soils formed in loamy material 20 to 40 inches deep to moderately fine or fine textured till or lacustrine material. Permeability is moderate in loamy material and slow or very slow in the substratum. Slope is the 0 to 2 percent.

Mermill soils are commonly adjacent to Haskins and Rawson soils and are similar to Colwood, Millgrove, and Wauseon soils. Haskins soils have a lighter colored surface layer and have less gray in the subsoil than Mermill soils. Rawson soils are brighter colored and are moderately well drained. Colwood soils have a mollic epipedon and are underlain by stratified loamy and sandy material. Millgrove soils have a mollic epipedon and are underlain by sand and gravel. Wauseon soils have a mollic epipedon and have less clay in the control section than Mermill soils.

Typical pedon of Mermill loam, about 0.75 mile south of Assumption, in Amboy Township; about 630 feet north and 1,340 feet east of the southwest corner of sec. 26, T. 9 S., R. 4 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam; gray (10YR 5/1) dry; weak medium granular structure; friable; few fine roots; 1 percent coarse fragments; medium acid; abrupt smooth boundary.

Btg1—9 to 18 inches; grayish brown (2.5Y 5/2) sandy clay loam; common fine distinct dark yellowish brown (10YR 4/4 and 10YR 4/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; common very dark gray (10YR 3/1) krotovinas; few fine distinct black (10YR 2/1) stains; 1 percent coarse fragments; slightly acid; clear wavy boundary.

Btg2—18 to 32 inches; grayish brown (2.5Y 5/2) sandy clay loam; many medium distinct dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; firm; few fine roots; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few pockets of sandy clay loam; common medium prominent (10YR 2/1) stains; 1 percent coarse fragments; neutral; clear wavy boundary.

2BCg—32 to 47 inches; gray (5Y 5/1) clay; many coarse distinct dark yellowish brown (10YR 4/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; few fine prominent black (10YR 2/1) stains; 2 percent coarse fragments; neutral grading to mildly alkaline; clear wavy boundary.

2Cg—47 to 60 inches; brown (10YR 4/3) clay loam; common medium distinct gray (10YR 5/1) mottles; massive; very firm; gray (5Y 5/1) coatings along cleavage planes; few fine distinct black (10YR 2/1) stains; strong effervescence; 5 percent coarse fragments; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 28 to 48 inches. The clayey subsoil is within 20 to 40 inches of the surface. The solum above the clayey subsoil is 0 to 10 percent coarse fragments. The subsoil and substratum are 0 to 5 percent coarse fragments. Reaction in the A and B horizons ranges from medium acid to neutral. The 2B horizon is neutral or mildly alkaline.

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. Texture is either loam, fine sandy loam, or clay loam.

The Bt horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 to 6; and chroma of 1 or 2. It is sandy clay loam, loam, or clay loam.

The 2B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay loam, silty clay loam, clay, or silty clay. Clay content is more than 35 percent.

The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 3. It is clay loam, silty clay loam, silty clay, or clay.

Millgrove Series

The Millgrove series consists of deep, very poorly drained soils on outwash plains, terraces, and beach ridges. These soils formed in loamy material 20 to 36 inches deep to sandy, gravelly, and loamy materials deposited by water. Permeability is moderate in the loamy material and moderately rapid in the substratum. Slope is 0 to 2 percent.

Millgrove soils are commonly adjacent to Brady, Digby, and Perrin soils and are similar to Colwood, Mermill, and Wauseon soils. Brady, Digby, Perrin, and Mermill soils do not have a mollic epipedon. In Brady and Digby soils, the matrix does not have dominantly low chroma. Perrin soils are brighter colored. Colwood soils have more silt than Millgrove soils and are underlain by loamy and fine sandy materials. Mermill soils have clayey material within a depth of 40 inches. Wauseon soils have more sand than Millgrove soils and have clayey material within a depth of 40 inches.

Typical pedon of Millgrove loam, about 4 miles northwest of Tedrow, in Gorham Township; about 240 feet west and 70 feet north of the southeast corner of sec. 26, T. 9 S., R. 1 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loam; grayish brown (10YR 5/2) dry; weak medium granular structure; friable; few fine roots; 2 percent coarse fragments; neutral; clear smooth boundary.

Bg—10 to 14 inches; dark gray (10YR 4/1) clay loam; common fine distinct dark yellowish brown (10YR 4/4) and few fine distinct gray (10YR 5/1) mottles; weak fine subangular blocky structure; firm; few fine roots; common very dark grayish brown (10YR 3/2) organic stains; 2 percent coarse fragments; neutral; clear smooth boundary.

Btg1—14 to 21 inches; gray (5Y 5/1) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few very dark grayish brown (10YR 3/2) organic stains; 2 percent coarse fragments; neutral; gradual smooth boundary.

Btg2—21 to 29 inches; gray (5Y 5/1) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few fine distinct very dark brown (10YR 2/2) stains (iron and manganese oxides); common fine distinct reddish brown (5YR 4/4) iron stains; 2 percent coarse fragments; neutral; gradual wavy boundary.

BCg—29 to 35 inches; gray (5Y 5/1) clay loam; few fine distinct yellowish brown (10YR 5/6) and reddish brown (5YR 4/4) mottles; weak fine subangular blocky structure; firm; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few fine distinct very dark brown (10YR 2/2) stains (iron and manganese oxides); 2 percent coarse fragments; neutral; clear wavy boundary.

2Cg—35 to 60 inches; grayish brown (10YR 5/2) gravelly sandy loam and thin strata of sandy loam and fine sandy loam; many fine distinct yellowish brown (10YR 5/6) and few fine distinct reddish brown (5YR 4/4) mottles; massive; weak effervescence; friable; 15 percent coarse fragments; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 32 to 48 inches. The solum is 2 to 15 percent coarse fragments, and the substratum is 15 to 40 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is medium acid to neutral. In some pedons, an A horizon is below the Ap horizon. This A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is either fine sandy loam, loam, or clay loam.

The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is sandy loam, sandy clay loam, clay loam, or loam. It is slightly acid to mildly alkaline.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is gravelly loam, gravelly sandy loam, sandy loam, fine sandy loam, or loam.

Nappanee Series

The Nappanee series consists of deep, somewhat poorly drained soils on lake plains. These soils formed in calcareous glacial till that has been reworked by the action of glacial lake waters. Permeability is slow. Slope ranges from 0 to 6 percent.

Nappanee soils are commonly adjacent to Hoytville and Glynwood soils and are similar to Blount, Del Rey, Fulton, and Haskins soils. Hoytville soils have a darker surface layer and are very poorly drained. Glynwood soils do not have dominantly low chroma in the upper 10 inches of the argillic horizon. Blount soils have less clay directly under the Ap horizon and in the substratum. Del Rey and Fulton soils have less sand and coarse fragments in the solum than Nappanee soils, and they formed in lacustrine deposits. Haskins soils have more sand in the upper part of the solum than Nappanee soils.

Typical pedon of Nappanee loam, 0 to 2 percent slopes, about 1 mile east of Delta, in Swan Creek Township; about 200 feet south and 2,375 feet east of the northwest corner of sec. 17, T. 7 N., R. 8 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam; pale brown (10YR 6/3) dry; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—6 to 10 inches; brown (10YR 4/3) clay; many medium distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; common fine distinct very dark gray (10YR 3/1) concretions (iron and manganese oxides); 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bt2—10 to 18 inches; brown (10YR 4/3) clay; common medium distinct grayish brown (10YR 5/2) mottles and dark grayish brown (10YR 4/2) ped surfaces that have few fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; very firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; common fine distinct very dark gray (10YR 3/1) concretions (iron and manganese oxides); 3 percent coarse fragments; neutral; abrupt wavy boundary.

Btg—18 to 26 inches; grayish brown (10YR 5/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; very firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; strong effervescence; 3 percent coarse fragments; mildly alkaline; gradual wavy boundary.

C—26 to 60 inches; brown (10YR 4/3) clay; common medium distinct yellowish brown (10YR 5/4) mottles; massive; very firm; dark gray (10YR 4/1) and grayish brown (10YR 5/2) coatings and few fine distinct light gray (10YR 7/2) lime coatings along cleavage planes; strong effervescence; 3 percent coarse fragments; moderately alkaline.

The solum is 19 to 38 inches thick. Free carbonates are at a depth of 18 to 34 inches. The solum and the substratum are 0 to 5 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is loam or silty clay loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is clay or silty clay and has thin subhorizons of clay loam or silty clay loam.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is glacial till of clay, clay loam, or silty clay loam.

Oakville Series

The Oakville series consists of deep, well drained soils on sand dunes, moraines, and beach ridges. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 12 percent.

Oakville soils are commonly adjacent to Granby, Ottokee, and Tedrow soils and are similar to Spinks soils. Granby soils have a mollic epipedon and are very poorly drained. Ottokee soils have lamellae and have mottles or a matrix of low chroma within a depth of 40 inches. Tedrow soils have mottles of low chroma within a depth of 20 inches. Spinks soils have an argillic horizon.

Typical pedon of Oakville fine sand, 0 to 6 percent slopes, about 1.5 miles northeast of Winameg, in Pike Township; about 1,780 feet north and 1,830 feet east of the southwest corner of sec. 34, T. 9 S., R. 3 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) fine sand; pale brown (10YR 6/3) dry; 10 percent dark yellowish brown (10YR 4/4) material from the B horizon; very weak medium subangular blocky structure; very friable; few fine roots; strongly acid; abrupt irregular boundary.

Bw1—9 to 15 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; few fine roots; few fine distinct very dark grayish brown (10YR 3/2) fillings in root channel; strongly acid; clear wavy boundary.

Bw2—15 to 27 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; few fine roots; strongly acid; gradual wavy boundary.

BC—27 to 39 inches; yellowish brown (10YR 5/4) fine sand; common fine distinct strong brown (7.5YR 5/6) mottles; single grained; loose; medium acid; gradual wavy boundary.

C—39 to 60 inches; brown (10YR 5/3) fine sand; single grained; loose; slightly acid.

The solum ranges from 24 to 40 inches in thickness. Carbonates range in depth from 40 inches to more than 60 inches. The solum is 0 to 3 percent gravel, but the substratum is usually free of gravel.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It ranges from strongly acid to neutral. In wooded areas, there is an A horizon 1 inch to 4 inches thick. This A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. It is fine sand or loamy fine sand. It ranges from strongly acid to neutral.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 2 to 6. It is fine sand or sand. It ranges from medium acid to neutral.

Oshtemo Series

The Oshtemo series consists of deep, well drained soils on beach ridges, outwash plains, and moraines. These soils formed in loamy and sandy materials sorted by water. Permeability is moderately rapid in the solum and very rapid in the substratum. Slope ranges from 0 to 6 percent.

Oshtemo soils are commonly adjacent to Gilford and Perrin soils and are similar to Boyer and Spinks soils. Gilford soils have a mollic epipedon and are very poorly drained. Perrin soils have mottles of low chroma in the solum. Boyer soils have a thinner solum than Oshtemo soils. Spinks soils have an argillic horizon that consists of lamellae.

Typical pedon of Oshtemo loamy sand, 0 to 6 percent slopes, about 1 mile east of Wauseon, in York Township; about 2,040 feet south and 115 feet east of the northwest corner of sec. 30, T. 7 N., R. 7 E.

Ap—0 to 10 inches; dark brown (10YR 3/3), loamy sand; pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common fine roots; 5 percent coarse fragments; neutral; abrupt smooth boundary.

E—10 to 17 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; common fine roots; 5 percent coarse fragments; medium acid; gradual wavy boundary.

Bt—17 to 26 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; thin patchy reddish brown (5YR 4/3) clay coatings on sand grains; 5 percent coarse fragments; slightly acid; gradual wavy boundary.

E/B—26 to 46 inches; yellowish brown (10YR 5/4) loamy sand (E); weak medium subangular blocky structure; very friable; lamellae and nodules of brown (7.5YR 4/4) and dark reddish brown (5YR 3/3) sandy loam (Bt); weak medium subangular blocky structure; friable; 5 percent coarse fragments; neutral; abrupt wavy boundary.

C—46 to 55 inches; pale brown (10YR 6/3) sand; single grained; loose; strong effervescence; 2 percent coarse fragments; moderately alkaline; abrupt smooth boundary.

2C—55 to 60 inches; brown (10YR 5/3) gravelly sand; single grained; loose; strong effervescence; 40 percent coarse fragments; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 44 to 55 inches. The solum is 3 to 25 percent coarse fragments, and individual subhorizons of the substratum are 2 to 45 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is medium acid to neutral. In wooded areas there is an A horizon 1 to 3 inches thick. This A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is loamy sand or sandy loam. It is medium acid or slightly acid.

The B horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 to 6. It is sandy loam, sandy clay loam, gravelly sandy loam, or gravelly sandy clay loam. Some pedons have thin subhorizons of loamy sand. The B horizon ranges from medium acid to neutral.

The C and 2C horizons have hue of 10YR, value of 5 or 6, and chroma of 2 to 4. They are generally moderately alkaline, but in some pedons they are mildly alkaline.

Ottokee Series

The Ottokee series consists of deep, moderately well drained soils on outwash plains, sand dunes, and beach ridges. These soils formed in sandy material. Permeability is rapid. Slope is 0 to 8 percent.

Ottokee soils are commonly adjacent to Glynwood, Granby, Oakville, and Tedrow soils and are similar to

Galen and Seward soils. Granby soils have a mollic epipedon and are very poorly drained. Oakville soils do not have mottles of low chroma within a depth of 40 inches. Tedrow soils have mottles of low chroma in the upper part of the solum. Galen soils have an argillic horizon. Seward soils have fine textured material within a depth of 40 inches. Glynwood soils formed in glacial till of clay loam and have more clay and gravel than Ottokee soils.

Typical pedon of Ottokee fine sand, 0 to 6 percent slopes, about 5 miles south of Delta, in York Township; about 2,500 feet south and 1,720 feet east of the northwest corner of sec. 12, T. 6 N., R. 7 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sand; light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

E1—8 to 22 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; slightly acid; clear wavy boundary.

E2—22 to 27 inches; light yellowish brown (10YR 6/4) fine sand; many fine prominent yellowish red (5YR 5/8 and 4/6) and common fine faint pale brown (10YR 6/3) mottles; single grained; loose; areas of numerous dark concretions (iron and manganese oxides); slightly acid; gradual wavy boundary.

E3—27 to 33 inches; pale brown (10YR 6/3) fine sand; few fine faint gray (10YR 6/1) mottles and fine and medium prominent strong brown (7.5YR 5/8) mottles that vary from few to many in short distances within the horizon; single grained; loose; slightly acid; clear wavy boundary.

E4—33 to 39 inches; light brownish gray (10YR 6/2) fine sand; fine and medium prominent yellowish brown (10YR 5/8) and brownish yellow (10YR 6/8) mottles that vary from few to many in a short distance within the horizon; single grained; loose; neutral; abrupt irregular boundary that has tongues extending into the horizon below.

E/B—39 to 60 inches; E part is light brownish gray (10YR 6/2) loamy fine sand in the upper part and pale brown (10YR 6/3) loamy fine sand in the lower part; single grained; loose; B part (Bt) is some discontinuous strong brown (7.5YR 5/8) loamy fine sand lamellae 1/8 to 3/4 inch thick that increase in thickness with depth; weak fine subangular blocky structure in some parts and massive in other parts; very friable; neutral; clear wavy boundary.

Cg—60 to 78 inches; gray (10YR 5/1) fine sand; many medium distinct light olive brown (2.5Y 5/6) mottles; single grained; loose; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates range from 40 to 90 inches. The solum is 0 to 5 percent gravel, and the substratum is 0 to 2 percent gravel.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is slightly acid or neutral.

The upper part of the E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. The lower part has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. The highest mottles of low chroma are at a depth of 16 to 30 inches. The reaction of the E horizon ranges from medium acid to neutral. The E horizon is fine sand, loamy fine sand, sand, and loamy sand.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 3. It is fine sand or sand. It is mildly alkaline or moderately alkaline, but in some pedons it ranges to slightly acid.

Perrin Series

The Perrin series consists of deep, moderately well drained soils on outwash plains, terraces, and beach ridges. These soils formed in loamy, sandy, and gravelly water deposits. Permeability is moderately rapid. Slope is 2 to 6 percent.

Perrin soils are commonly adjacent to Brady, Digby, Millgrove, and Oshtemo soils and are similar to Rawson and Tuscola soils. Brady soils have mottles of low chroma in the upper 10 inches of the control section. Digby soils have dominantly low chroma in the argillic horizon and have more clay in the subsoil than Perrin soils. Millgrove soils have a mollic epipedon and are very poorly drained. Oshtemo soils are brighter colored in the subsoil. Rawson soils have clayey material within a depth of 40 inches. Tuscola soils have more silt and less gravel than Perrin soils and are underlain by stratified very fine sandy and silty material.

Typical pedon of Perrin sandy loam, 2 to 6 percent slopes, about 5 miles southwest of Wauseon, in Clinton Township; 1,550 feet west and 1,050 feet north of the southeast corner of sec. 9, T. 6 N., R. 5 E.

Ap—0 to 12 inches; dark brown (10YR 3/3) sandy loam; light yellowish brown (10YR 6/4) dry; moderate fine granular structure; friable; few fine roots; 10 percent coarse fragments; neutral; abrupt smooth boundary.

Bt1—12 to 17 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium faint brown (10YR 5/3) and few fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine roots; common fine distinct black (10YR 2/1) accumulations (iron and manganese oxides); thin very patchy dark brown (10YR 4/3) clay films; 5 percent coarse fragments; neutral; gradual wavy boundary.

Bt2—17 to 25 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; 5 percent coarse fragments; common fine distinct black (10YR 2/1) stains on pebbles (iron and manganese oxides); thin very patchy dark brown (10YR 4/3) clay films; neutral; clear wavy boundary.

Bt3—25 to 30 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct grayish brown (10YR 5/2) and common fine faint dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; common fine distinct black (10YR 2/1) accumulations (iron and manganese oxides); thin very patchy dark grayish brown (10YR 4/2) clay films; 10 percent coarse fragments; neutral; clear wavy boundary.

2C—30 to 60 inches; yellowish brown (10YR 5/4) gravelly sandy loam; common medium faint yellowish brown (10YR 5/6) mottles; massive; friable; few fine distinct black (10YR 2/1) accumulations (iron and manganese oxides); strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 40 inches. The solum is 5 to 20 percent coarse fragments, and the substratum is 10 to 40 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It ranges from medium acid to neutral.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, gravelly sandy loam, gravelly sandy clay loam, or sandy clay loam. It ranges from medium acid to neutral in the upper part and is slightly acid or neutral in the lower part.

The 2C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is gravelly sandy loam, gravelly loamy sand, or stratified sand and gravel. It is mildly alkaline or moderately alkaline.

Pewamo Series

The Pewamo series consists of deep, very poorly drained soils on till plains and moraines. These soils formed in glacial till of clay loam. Permeability is moderately slow. Slope is 0 to 2 percent.

Pewamo soils are commonly adjacent to Blount and Glynwood soils and are similar to Hoytville soils. Blount soils do not have a mollic epipedon and have less gray in the subsoil than Pewamo soils. Glynwood soils are not dominated by low chroma and do not have a mollic epipedon. Hoytville soils do not have a mollic epipedon.

Typical pedon of Pewamo clay loam, about 2.5 miles northwest of Fayette, in Gorham Township; about 75 feet north and 700 feet west of the southeast corner of sec. 12, T. 9 S., R. 1 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) clay loam; grayish brown (10YR 5/2) dry; weak coarse subangular blocky structure and weak medium granular structure; firm; few fine roots; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bg—10 to 14 inches; dark gray (10YR 4/1) clay loam; many medium distinct brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin very patchy very dark gray (10YR 3/1) organic coatings on faces of peds; medium continuous dark gray (10YR 4/1) clay films on faces of peds; 2 percent coarse fragments; slightly acid; gradual wavy boundary.

Btg1—14 to 28 inches; gray (10YR 5/1) clay loam; many medium distinct dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; thin patchy dark gray (10YR 4/1) clay films on faces of peds; 2 percent coarse fragments; slightly acid; diffuse wavy boundary.

Btg2—28 to 46 inches; gray (10YR 5/1) clay; many coarse distinct dark yellowish brown (10YR 4/6) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; thin patchy gray (10YR 5/1) clay films on faces of peds; 3 percent coarse fragments; slightly acid; diffuse wavy boundary.

BCg—46 to 57 inches; gray (10YR 5/1) and dark yellowish brown (10YR 4/6) silty clay; weak coarse subangular blocky structure; firm; few fine distinct black (10YR 2/1) stains; 2 percent coarse fragments; neutral; clear wavy boundary.

Cg—57 to 60 inches; gray (10YR 5/1) and dark yellowish brown (10YR 4/6) silty clay loam; massive; firm; 2 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 33 to 60 inches in thickness. The mollic epipedon ranges from 10 to 14 inches in thickness. Carbonates range in depth from 28 to 60 inches. The solum and the underlying glacial till are 2 to 10 percent coarse fragments.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is slightly acid or neutral loam or clay loam.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay loam, silty clay loam, clay, or silty clay. Reaction in the B horizon ranges from slightly acid to mildly alkaline. Reaction becomes more alkaline as depth increases.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay loam or silty clay loam.

Rawson Series

The Rawson series consists of deep, moderately well drained soils on outwash plains and beach ridges. These soils formed in moderately coarse material 20 to 40 inches deep to moderately fine and fine till or lacustrine material. Permeability is moderate in the moderately coarse material and slow or very slow in the moderately fine and fine textured material. Slope is 2 to 6 percent.

Rawson soils are commonly adjacent to Haskins and Mermill soils and are similar to Perrin and Tuscola soils. Haskins soils are somewhat poorly drained. Mermill soils have a darker surface layer and are very poorly drained. Perrin soils are underlain by gravelly material. Tuscola soils do not have coarse fragments and are underlain by stratified silt loam and very fine sand.

Typical pedon of Rawson sandy loam, 2 to 6 percent slopes, about 1.5 miles east of Wauseon, in York Township; about 320 feet south and 2,300 feet east of the northwest corner of sec. 30, T. 7 N., R. 7 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) sandy loam; pale brown (10YR 6/3) dry; weak medium granular structure; friable; few fine roots; 5 percent coarse fragments; strongly acid; abrupt smooth boundary.

Bt1—10 to 19 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct dark brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable; few fine roots; thin very patchy dark brown (10YR 4/3) clay films on faces of peds and clay bridges between sand grains; 10 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt2—19 to 28 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark brown (10YR 4/3) clay films on faces of peds; 10 percent coarse fragments; neutral; gradual wavy boundary.

Bt3—28 to 32 inches; dark brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; common medium distinct very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); 10 percent coarse fragments; neutral; abrupt smooth boundary.

2Bt4—32 to 36 inches; dark brown (10YR 4/3) clay loam, common medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) mottles; weak, medium subangular blocky structure; firm; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 5 percent coarse fragments; neutral; abrupt wavy boundary.

2C—36 to 60 inches; brown (10YR 5/3) clay loam; common medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) mottles; massive; very firm; common light gray (10YR 7/2) lime coatings on cleavage faces; strong effervescence; 3 percent coarse fragments; moderately alkaline.

The solum ranges from 28 to 44 inches in thickness. Typically, it extends into the underlying fine textured material. The upper part of the solum is 2 to 20 percent coarse fragments, and the finer textured, lower part of the solum and the underlying material are 0 to 8 percent coarse fragments.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is from neutral to strongly acid sandy loam or loam.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly sandy clay loam or clay loam, but in places individual subhorizons are loam or sandy loam. It is medium acid to neutral.

Where present, the 2B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is neutral or mildly alkaline silty clay loam, clay loam, clay, or silty clay.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is mildly alkaline or moderately alkaline clay, clay loam, silty clay, or silty clay loam.

Rimer Series

The Rimer series consists of deep, somewhat poorly drained soils on outwash plains, beach ridges, and deltas. These soils formed in sandy material 20 to 32 inches deep to fine or moderately fine textured material. Permeability is rapid in the sandy material and slow or very slow in the loamy or clayey substratum. Slope is 0 to 3 percent.

Rimer soils are commonly adjacent to Blount, Seward, and Wauseon soils and are similar to Bixler and Tedrow soils. Blount soils formed in glacial till of clay loam and have more clay in the surface layer and upper part of the subsoil than Rimer soils. Seward soils do not have low chroma colors in the upper part of the argillic horizon. Wauseon soils have a mollic epipedon and are very poorly drained. Bixler soils have less clay in the argillic horizon and are underlain by stratified silt loam and very fine sand. Tedrow soils are sandy throughout and do not have moderately fine or fine textures in the lower part of the subsoil or substratum.

Typical pedon of Rimer loamy fine sand, 0 to 3 percent slopes, about 2 miles west of Pettisville, in German Township; about 900 feet north and 57 feet east of the southwest corner of sec. 26, T. 7 N., R. 5 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy fine sand; pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few medium roots; neutral; abrupt smooth boundary.

E—9 to 23 inches; yellowish brown (10YR 5/4) fine sand; many coarse distinct light brownish gray (10YR 6/2) and common fine distinct strong brown (7.5YR 5/6) mottles; single grained; very friable; few fine roots; few dark brown (10YR 3/3) krotovinas; neutral; clear wavy boundary.

Bt—23 to 29 inches; dark yellowish brown (10YR 4/4) fine sandy loam; many medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very friable; few fine roots; grayish brown

(10YR 5/2) faces of peds; clay bridges between sand grains; few fine distinct black (10YR 2/1) concretions (iron and manganese oxides); neutral; abrupt wavy boundary.

2Btg—29 to 33 inches; grayish brown (10YR 5/2) clay; many medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; few fine distinct black (10YR 2/1) concretions; thin very patchy grayish brown (10YR 5/2) clay films on faces of peds; neutral grading to mildly alkaline in lower part; abrupt wavy boundary.

2Cg—33 to 60 inches; gray (10YR 5/1) and dark yellowish brown (10YR 4/4) silty clay loam; massive; very firm; few fine roots; light gray (10YR 6/1) coatings on faces of cleavage planes; strong effervescence; moderately alkaline.

The solum ranges from 26 to 44 inches in thickness. The loamy fine sand or fine sand ranges from 20 to 32 inches in thickness. The solum is 0 to 3 percent gravel and the substratum is 0 to 5 percent gravel.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Reaction ranges from medium acid to neutral.

The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is loamy fine sand or fine sand. Reaction in the E horizon ranges from medium acid to neutral.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is fine sandy loam or sandy loam. Some pedons have thin subhorizons of sandy clay loam. Reaction in the Bt horizon ranges from medium acid to neutral.

The 2Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is clay loam, silty clay loam, clay, or silty clay. Reaction in the 2Bt horizon ranges from slightly acid to mildly alkaline.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. Texture is clay loam, silty clay loam, clay, or silty clay. Reaction in the 2C horizon is mildly alkaline or moderately alkaline.

Seward Series

The Seward series consists of deep, moderately well drained soils on outwash plains, beach ridges, and deltas. These soils formed in coarse and moderately coarse material 20 to 32 inches deep to moderately fine and fine textured material. Permeability is rapid in the coarse and moderately coarse material and slow or very slow in the loamy or clayey substratum. Slope ranges from 2 to 12 percent.

Seward soils are commonly adjacent to Rimer and Wauseon soils and are similar to Ottokee soils. Rimer soils have low-chroma colors in the upper part of the argillic horizon. Wauseon soils have a mollic epipedon and are very poorly drained. Ottokee soils are sandy throughout and do not have moderately fine or fine textures in the lower part of the subsoil and the substratum.

Typical pedon of Seward loamy fine sand, 2 to 6 percent slopes, about 2 miles southeast of Pettisville, in Clinton Township; about 1,750 feet north and 1,050 feet west of the southeast corner of sec. 5, T. 7 N., R. 6 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) loamy fine sand; brown (10YR 5/3) dry; weak fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

E—10 to 22 inches; yellowish brown (10YR 5/4) loamy fine sand; weak medium subangular blocky structure; very friable; common fine roots; dark brown (10YR 4/3) krotovinas; 1 percent coarse fragments; slightly acid; abrupt wavy boundary.

Bt1—22 to 29 inches; dark brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; very friable; common fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; clay bridges between sand grains; 2 percent coarse fragments; neutral; clear wavy boundary.

Bt2—29 to 37 inches; dark yellowish brown (10YR 4/4) sandy loam; many medium distinct brown (10YR 5/3) mottles; weak medium subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine very dark brown (10YR 2/2) accumulations (iron and manganese oxides); 2 percent coarse fragments; neutral; abrupt wavy boundary.

2BC—37 to 40 inches; brown (10YR 4/3) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; 3 percent coarse fragments; mildly alkaline; clear wavy boundary.

2C—40 to 60 inches; brown (10YR 5/3) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; very firm; mildly alkaline; strong effervescence; 3 percent coarse fragments.

The thickness of the solum and the depth to carbonates are 25 to 44 inches. The sandier part of the solum is 20 to 37 inches thick. Gravel makes up 0 to 3 percent of the sandy material and 0 to 8 percent of the finer textured material.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid or slightly acid.

The E horizon has hue of 10YR or 7.5Y and value and chroma of 4 to 6. It is loamy fine sand or fine sand and is slightly acid to medium acid.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam or fine sandy loam and has thin subhorizons of sandy clay loam. It is slightly acid or neutral.

The 2B horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is clay loam, silty clay loam, clay, or silty clay. It is neutral or mildly alkaline.

The 2C horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is clay loam, clay, or silty clay.

Shinrock Series

The Shinrock series consists of deep, moderately well drained soils on lake plains. These soils formed in clayey lake sediment. Permeability is moderately slow. Slope ranges from 2 to 12 percent.

Shinrock soils are commonly adjacent to Fulton, Latty, and Tuscola soils and are similar to Glynwood soils. Fulton soils have mottles of low chroma in the upper part of the argillic horizon. Latty soils are very poorly drained. Tuscola soils have less clay than Shinrock soils and more fine sand and silt. Glynwood soils formed in glacial till and have coarse fragments.

Typical pedon of Shinrock silty clay loam, 6 to 12 percent slopes, eroded, about 2 miles east of Archbold, about 300 feet south and 900 feet east of the northwest corner of sec. 2, R. 5 E., T. 7 N.

Ap—0 to 5 inches; brown (10YR 4/3) silty clay loam; pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very firm; neutral; abrupt smooth boundary.

Bt1—5 to 12 inches; brown (10YR 4/3) silty clay; common fine faint brown (10YR 5/3) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

Bt2—12 to 26 inches; brown (10YR 4/3) silty clay; common medium distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) mottles; moderate fine angular blocky structure; very firm; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; weak effervescence; mildly alkaline; diffuse wavy boundary.

C—26 to 60 inches; brown (10YR 4/3) silty clay; many medium distinct grayish brown (10YR 5/2) mottles; massive; very firm; strong effervescence; moderately alkaline.

The solum is 18 to 38 inches thick. Carbonates are at a depth of 11 to 30 inches. The upper part of the solum is medium acid to neutral, and the lower part is slightly acid to moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. In wooded areas there is an A horizon 2 to 4 inches thick. This A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay or clay. It ranges from slightly acid to mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, chroma of 3 or 4. It is mottled silty clay and thin strata of silty clay loam, silt loam, silt, or fine sand.

Shoals Series

The Shoals series consists of deep, somewhat poorly drained soils on flood plains. These soils formed in loamy alluvium. Permeability is moderate. Slope is 0 to 2 percent.

Shoals soils are commonly adjacent to Eel and Sloan soils. Eel soils are brighter colored than Shoals soils. Sloan soils are dominantly gray directly below a mollic epipedon.

Typical pedon of Shoals silt loam, frequently flooded, about 2 miles north of Elmira, in Franklin Township; about 1,450 feet north and 365 feet east of the southwest corner of sec. 33, T. 8 N., R. 1 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam; pale brown (10YR 6/3) dry; weak medium granular structure; friable; few fine roots; thin patchy very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; abrupt smooth boundary.

C—11 to 19 inches; brown (10YR 4/3) silty clay loam; common medium distinct yellowish brown (10YR 5/4) and dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; friable; few fine roots; few very fine very dark brown (10YR 2/2) accumulations (iron and manganese oxides); neutral; gradual wavy boundary.

Cg1—19 to 28 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few fine roots; few fine very dark brown (10YR 2/2) concretions (iron and manganese oxides); neutral; abrupt wavy boundary.

Cg2—28 to 48 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; many medium distinct very dark brown (10YR 2/2) concretions (iron and manganese oxides); few very dark grayish brown (10YR 3/2) organic materials; neutral; gradual wavy boundary.

Cg3—48 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common medium distinct dark yellowish brown (10YR 4/4) and light olive brown (2.5Y 5/4) mottles; massive; friable; common medium distinct very dark grayish brown (10YR 2/2) concretions (iron and manganese oxides); neutral.

The reaction in the upper 40 inches of the Shoals soils ranges from slightly acid to mildly alkaline. Below a depth of 40 inches, it is slightly acid to moderately alkaline.

The A horizon is 8 to 12 inches thick. It has hue of 10YR, value of 4 or 5, and chroma of 1 or 2.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam, silt loam, or silty clay loam. Some pedons have thin subhorizons of sandy loam or loamy fine sand.

Sloan Series

The Sloan series consists of deep, very poorly drained soils on flood plains. These soils formed in loamy alluvium. Permeability is moderate or moderately slow. Slope is 0 to 2 percent.

Sloan soils are commonly adjacent to Eel and Shoals soils and are similar to Cohoctah soils. Eel soils are better drained and have brighter colors in the control section than Sloan soils. The Eel and Shoals soils do not have a mollic epipedon. The Shoals soils are not dominated by low chroma colors directly below the surface horizon. Cohoctah soils have more sand in the control section than Sloan soils.

Typical pedon of Sloan silty clay loam, frequently flooded, about 3 miles southeast of Fayette, in Gorham Township; about 2,490 feet south and 170 feet east of the northwest corner of Sec. 35, T. 9 S., R. 1 E.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam; grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; firm; few fine roots; neutral; abrupt smooth boundary.

Bg1—12 to 19 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; common medium distinct very dark gray (10YR 3/1) organic stains; few fine roots; neutral; gradual wavy boundary.

Bg2—19 to 31 inches; dark grayish brown (2.5Y 4/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; neutral; gradual wavy boundary.

BCg—31 to 45 inches; grayish brown (10YR 5/2) clay loam; common medium distinct dark brown (7.5YR 4/4) mottles; massive; friable; common medium distinct reddish brown (5YR 5/4) old root channels; neutral; gradual wavy boundary.

Cg—45 to 60 inches; grayish brown (2.5Y 5/2) stratified silty clay loam and loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; common medium distinct reddish brown (5YR 5/4); old root channels; mildly alkaline.

The solum ranges from 25 to 55 inches in thickness. The mollic epipedon ranges from 10 to 16 inches in thickness.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is either silty clay loam or clay loam.

The B horizon has hue of 10YR, 2.5Y, or N; value of 4 or 5; and chroma of 0 to 2. It is loam, silt loam, silty clay loam, or clay loam. Reaction in the B horizon ranges from slightly acid to mildly alkaline in the upper part and from neutral to moderately alkaline in the lower part.

The C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, silt loam, silty clay loam, or clay loam. Some pedons have thin layers of loamy sand.

Spinks Series

The Spinks series consists of deep, well drained soils on moraines, outwash plains, and beach ridges. These soils formed in sandy material. Permeability is moderately rapid. Slope ranges form 1 to 18 percent.

Spinks soils are commonly adjacent to Granby, Ottokee, and Tedrow soils and are similar to Boyer, Oakville, and Oshtemo soils. Granby soils have a mollic epipedon and are very poorly drained. Ottokee soils do not have an argillic horizon. They have mottles or matrix of low chroma within 40 inches of the surface. Tedrow soils have mottles of low chroma in the upper part of the subsoil. Boyer and Oshtemo soils have a continuous argillic horizon and more clay than Spinks soils. Oakville soils do not have lamellae.

Typical pedon of Spinks fine sand, 6 to 12 percent slopes, about 2.5 miles east of Winameg, in Pike Township; about 1,250 feet north and 775 feet west of the southeast corner of sec. 1, T. 10 S., R. 3 E.

Ap—0 to 8 inches; brown (10YR 4/3) fine sand; brown (10YR 5/3) dry; single grained; loose; few fine roots; medium acid; abrupt smooth boundary.

E—8 to 18 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; common medium roots; medium acid; abrupt wavy boundary.

E/Bt—18 to 64 inches; yellowish brown (10YR 5/4) fine sand (E); single grained; loose; common lamellae of brown (7.5YR 4/4) loamy fine sand (Bt); weak fine subangular blocky structure; friable; few medium roots; medium acid; abrupt wavy boundary.

C—64 to 80 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; few coarse distinct white (10YR 8/1) lime accumulations; strong effervescence; moderately alkaline.

The solum ranges from 36 to 66 inches or more in thickness. It ranges from medium acid to neutral and is 0 to 15 percent coarse fragments. The first lamellae are at a depth of 15 to 36 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3.

The E horizon above the lamellae and between the lamellae has hue of 10YR, value of 4 to 6, and chroma of 4 to 6. It is fine sand, sand, loamy fine sand, or loamy sand.

The Bt horizon is lamellae that have an accumulative thickness of 6 inches or more. It has a hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand, loamy sand, loamy fine sand, or fine sand. In places thin bands of sandy loam are present.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sand or fine sand. It ranges from neutral to moderately alkaline.

Tedrow Series

The Tedrow series consists of deep, somewhat poorly drained soils on outwash plains and beach ridges. These soils formed in sandy material. Permeability is rapid. Slope is 0 to 3 percent.

Tedrow soils are commonly adjacent to Granby, Oakville, Ottokee, and Spinks soils and are similar to Bixler and Rimer soils. Granby soils have a mollic epipedon and are grayer than Tedrow soils. Oakville and Spinks soils are brighter colored and do not have mottles or matrix of low chroma within a depth of 40 inches. Ottokee soils have mottles of low chroma in the lower part of the B horizon and are brighter colored than Tedrow soils. Bixler soils have loamy material within a depth of 40 inches, and Rimer soils have clayey material within a depth of 40 inches.

Typical pedon of Tedrow loamy fine sand, 0 to 3 percent slopes, about 2.75 miles northeast of Tedrow, in Chesterfield Township; 1,690 feet north and 1,470 feet west of the southeast corner of sec. 32, T. 9 S., R. 2 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand; grayish brown (10YR 5/2) dry; very weak fine granular structure; very friable; few fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 14 inches; dark yellowish brown (10YR 4/4) loamy fine sand; common fine distinct grayish brown (10YR 5/2) and few fine distinct brown (7.5YR 4/4) mottles; single grained; loose; few fine roots; few fine distinct very dark brown (10YR 2/2) concretions; slightly acid; clear wavy boundary.

Bw2—14 to 26 inches; brown (10YR 4/3) loamy fine sand; few fine distinct light brownish gray (2.5Y 6/2) mottles; single grained; loose; few fine roots; slightly acid; clear wavy boundary.

Cg1—26 to 45 inches; grayish brown (2.5Y 5/2) fine sand; common fine distinct dark grayish brown (10YR 4/2) mottles; single grained; loose; neutral; gradual wavy boundary.

Cg2—45 to 60 inches; grayish brown (10YR 5/2) fine sand; common coarse distinct dark yellowish brown (10YR 4/6) and common fine distinct dark grayish brown (10YR 4/2) mottles; single grained; loose; neutral.

The solum ranges from 24 to 48 inches in thickness. Reaction of the solum is slightly acid or neutral.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. In places individual subhorizons have chroma of 2 or less. The B horizon is loamy fine sand, loamy sand, fine sand, or sand.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is fine sand or sand. Reaction of the C horizon ranges from neutral to moderately alkaline.

Tuscola Series

The Tuscola series consists of deep, moderately well drained soils on outwash plains, beach ridges, and deltas. These soils formed in stratified silty and sandy materials. Permeability is moderate. Slope ranges from 3 to 8 percent.

Tuscola soils are commonly adjacent to Colwood, Kibbie, and Shinrock soils and are similar to Perrin and Rawson soils. Colwood soils have a mollic epipedon and are very poorly drained. Kibbie soils are grayer in the upper part of the argillic horizon. Shinrock soils have more clay throughout than Tuscola soils. Perrin soils have more gravel than Tuscola soils and are underlain by sand and gravel. Rawson soils have more gravel and more clay in the lower part of the subsoil and the substratum.

Typical pedon of Tuscola fine sandy loam, 3 to 8 percent slopes; about 1.5 miles northeast of Tedrow, in Dover Township; about 740 feet north and 2,475 feet west of the southeast corner of sec. 5, T. 10 S., R. 2 E.

Ap—0 to 10 inches; brown (10YR 4/3) fine sandy loam; pale brown (10YR 6/3) dry; weak fine granular structure; friable; few fine roots; 15 percent dark yellowish brown (10YR 4/4) material from the Bw horizon; slightly acid; abrupt smooth boundary.

Bw—10 to 16 inches; dark yellowish brown (10YR 4/4) very fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; common fine pores; thin very patchy brown (10YR 5/3) silt coatings; few fine distinct black (10YR 2/1) stains (iron and manganese oxides); slightly acid; clear wavy boundary.

Bt1—16 to 23 inches; dark yellowish brown (10YR 4/4) loam and bands of silty clay loam and very fine sandy loam; brown (10YR 5/3) on faces of peds; few fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; common fine distinct black (10YR 2/1) stains (iron and manganese oxides); thin patchy dark yellowish brown (10YR 4/4) clay films; medium acid; gradual wavy boundary.

Bt2—23 to 31 inches; dark yellowish brown (10YR 4/4) silt loam and bands of silty clay loam and very fine sandy loam; brown (10YR 5/3) on faces of peds; few fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; common fine pores; few fine distinct black (10YR 2/1) stains (iron and manganese oxides); medium very patchy dark yellowish brown (10YR 4/4) clay films; medium acid; gradual wavy boundary.

Bt3—31 to 43 inches; dark yellowish brown (10YR 4/4) silt loam and thick bands of very fine sandy loam and thin bands of silty clay loam; brown (10YR 5/3) on faces of peds; few fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; common fine pores; few fine distinct black (10YR 2/1) stains (iron and manganese oxides); thin very patchy dark yellowish brown (10YR 4/4) clay films; neutral; clear wavy boundary.

C—43 to 60 inches; yellowish brown (10YR 5/4) stratified very fine sandy loam, loamy very fine sand, and very fine sand; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive with distinct platy structure between strata; very friable; light gray (10YR 7/2) lime concentrations between layers; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 30 to 44 inches. The solum is 0 to 3 percent coarse fragments, but the substratum is free of fragments.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is medium acid to neutral fine sandy loam, very fine sandy loam, or silt loam.

The B horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is very fine sandy loam, loam, silt loam, clay loam, or silty clay loam. Reaction of the B horizon ranges from medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 4. It is stratified silt loam, very fine sandy loam, very fine sand, fine sand, loamy very fine sand, and silty clay loam. Thin strata of silty clay or silt are in some pedons. The C horizon is mildly alkaline or moderately alkaline.

Wauseon Series

The Wauseon series consists of deep, very poorly drained soils on outwash plains, beach ridges, and deltas. These soils formed in loamy material underlain by moderately fine or fine textured material. Permeability is rapid in the loamy material and very slow in the loamy or clayey substratum. Slope is 0 to 2 percent.

Wauseon soils are commonly adjacent to Rimer and Seward soils and are similar to Lamson, Mermill, and Millgrove soils. Rimer, Seward, Lamson, and Mermill soils do not have a mollic epipedon. Rimer and Seward soils do not have dominantly low chroma in the upper part of the solum. Lamson soils are underlain by stratified silt loam and very fine sand. Mermill soils have more clay in the upper part of the solum than Wauseon soils. Millgrove soils also have more clay in the upper part of the solum than Wauseon soils and are underlain by medium and moderately coarse textured material.

Typical pedon of Wauseon fine sandy loam, about 1.5 miles northeast of Winameg, in Pike Township; about 195 feet north and 1,495 feet west of the southeast corner of sec. 34, T. 9 S., R. 3 E.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam; moderate fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

A—9 to 13 inches; black (10YR 2/1) fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; slightly acid; abrupt wavy boundary.

Bg1—13 to 21 inches; dark gray (10YR 4/1) fine sandy loam; common fine distinct yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; friable; few fine roots; common medium distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; clear wavy boundary.

Bg2—21 to 28 inches; dark gray (10YR 4/1) fine sandy loam; common medium distinct yellowish brown (10YR 5/4) and olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; few fine roots; common fine distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; 1 percent coarse fragments; mildly alkaline; clear wavy boundary.

Bg3—28 to 32 inches; dark gray (10YR 4/1) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; common medium distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; mildly alkaline, slight effervescence; abrupt wavy boundary.

2C—32 to 60 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4) mottles; massive; very firm; gray (10YR 6/1) coatings on cleavage planes; 2 percent coarse fragments; moderately alkaline; strong effervescence.

Thickness of the solum and depth to the substratum are 24 to 40 inches. The mollic epipedon ranges from 10 to 14 inches in thickness. The solum is 0 to 3 percent coarse fragments, and the substratum is 0 to 5 percent coarse fragments. Reaction is neutral or slightly acid in the A horizon and slightly acid to mildly alkaline in the Bg horizon.

The Ap and A horizon have 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 dominantly fine sandy loam or sandy loam but includes loamy fine sand, very fine sand, and sandy clay loam layers up to 5 inches thick.

The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is clay, silty clay, clay loam, or silty clay loam.

Formation of the Soils

This section discusses the factors of soil formation, relates them to the formation of the soils in the survey area, and explains the processes of soil formation.

Factors of Soil Formation

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.

Climate

Climate is largely responsible for the kind of vegetation in an area. The climate in Fulton County has been relatively uniform for a long period of time. 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, causing many soils to be acid to a moderate depth. In most soils, differences in soil reaction in the upper 2 feet can be partly attributed to the 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, Digby, and Blount 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. Differences in relief, however, have resulted in differences in the microclimate in some areas.

All the soils in Fulton 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. This soil temperature ranges from 47 degrees F (8 degrees C) to 59 degrees F (15 degrees C).

Plants and Animals

The hardwood trees in Fulton County have greatly affected soil formation. Soils in the northwestern, central, and southeastern parts of the county formed under forest vegetation comprised of several species of oak and other hardwood trees. Soils in the western and eastern parts of the county and other low lying areas formed under swamp forest vegetation that was comprised mainly of 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 relatively low in accumulated bases. Organic deposits, the parent material of Adrian 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. Windthrown trees, particularly in areas of the poorly drained soils, also have caused mixing of soil material. In wooded areas of poorly drained soils, holes created by fallen trees have resulted in a pronounced microrelief of low knolls and depressions.

In most areas, the soils have been cleared of trees and used as cropland. Many areas in the Oak Openings have been reforested.

The Oak Openings is a large beach of a former glacial lake in the southeastern part of the county. Oak forest is the natural vegetation. 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 Fulton County are glacial till, lacustrine sediment, glacial lake-beach ridge deposits, deltaic sediment deposited in postglacial lakes, and recent alluvium (fig. 14). Parent material has greatly affected the texture of the soils.

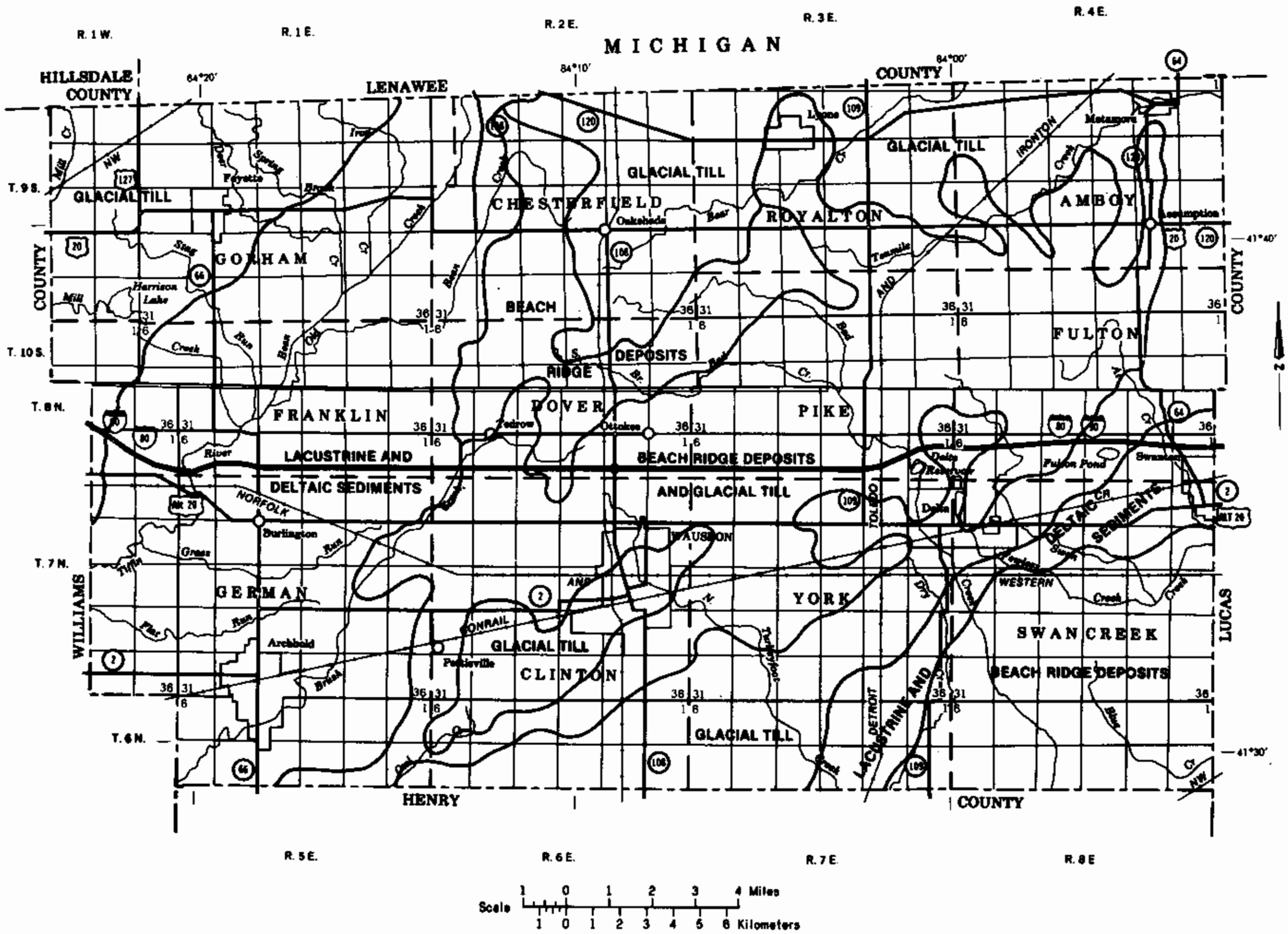


Figure 14.—Location and extent of the different kinds of parent material in Fulton County, Ohio.

Blount, Glynwood, Hoytville, and Nappanee soils formed in glacial till of clay loam. Ottokee and Tedrow soils formed in sandy beach deposits. Colwood, Dixboro, Kibbie, Lamson, and Tuscola soils formed in deltaic sediment of silty or loamy materials. Latty and Fulton soils formed in clayey lacustrine deposits. The rest of the soils in the county formed in mixed parent material. Many of their characteristics were determined by the proportion and sequence of the layers of these different materials.

The parent materials of most of the soils in the county were relatively high in calcium and magnesium carbonates. Weathering of the parent material reduced the amount of carbonates that remain in the surface layer and upper part of the subsoil.

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 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 Blount, Granby, and Latty soils, have a seasonal high water table.

Because of rapid runoff and erosion, the sloping and steep soils in a series generally are thinner than the nearly level soils in the same series. The lower rates of percolation and leaching in the sloping and steep soils result in less weathering of the parent material.

Differences in drainage among soils that formed in similar parent material 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 in 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 are less sloping than the Oakville and Ottokee soils. Granby soils are very poorly drained; they are in the lowest positions on the landscape.

In Fulton County, the steepest soils are on the sandy beach ridges in the southeastern part of the county, in the northwestern part, in the central part near Oakshade, and along major drainageways. The rest of the county is nearly level or gently sloping. Most poorly drained soils are nearly level.

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 has been 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 Fulton 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 Cohoctah, Eel, 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 Fulton County have been forming 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 known as additions, losses, transfers, and alterations (*6*). 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 to the soil is the accumulation of organic matter in the surface layer. Others are bases derived from organic matter, ground water, or lime and fertilizer and depositions resulting from erosion. The dark surface layer of Colwood, Gilford, Hoytville, and Mermill soils is caused by the addition of organic matter. All the soils in Fulton County have some organic matter accumulation; however, where the layer of accumulation was originally thin, plowing and cultivating have largely destroyed it or incorporated it into other layers. The Blount, Fulton, Glynwood, Nappanee, and Oakville soils are examples of soils that have limited additions 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 materials deposited by floodwaters.

Losses. Losses 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 kinds of loss in the soils in Fulton 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 18 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. 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 Fulton 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 process 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. Blount, Del Rey, Fulton, Haskins, and Nappanee 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 of Fulton 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. The reduction of iron, called gleying, is evident in Colwood, Granby, Hoytville, Lamson, Latty, and Pewamo 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. In the soils of Fulton County, iron commonly has been moved only a short distance within the soil.

Some of the iron is reoxidized and segregated and has formed bright yellow and red mottles. The mottles observed in all but the well drained soils have formed by this alteration of iron, which is caused by the fluctuating water table. Accumulations of iron and manganese oxides are common in the somewhat poorly drained and very poorly drained soils. They are dark brown or black blotches on the face of peds or small concretions about the size and shape of shot.

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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

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.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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.

Conservation tillage. A tillage system which does not invert the soil and which leaves a protective amount of crop residue on the surface throughout the year.

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.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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.

Depth to rock (in tables). 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 they are wet 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.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

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.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

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.

E horizon. Mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these. This leaves a concentration of sand and silt particles of quartz or other resistant materials.

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.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. 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.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

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.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

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.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

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 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, 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.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

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 filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

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 ground-water 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.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of 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.

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.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface horizon (A, E, AB, EB) below the surface layer.

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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 loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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 lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.