United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Ohio Department of Natural
Resources, Division of Soil
and Water Conservation, and
Ohio Agricultural Research
and Development Center

Soil Survey of Marion County, Ohio

HOW TO USE

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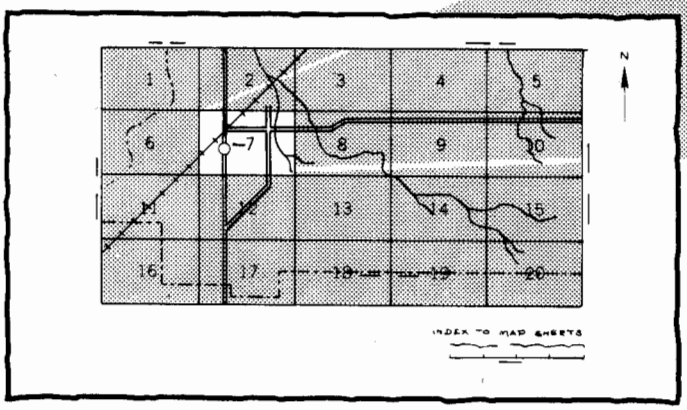

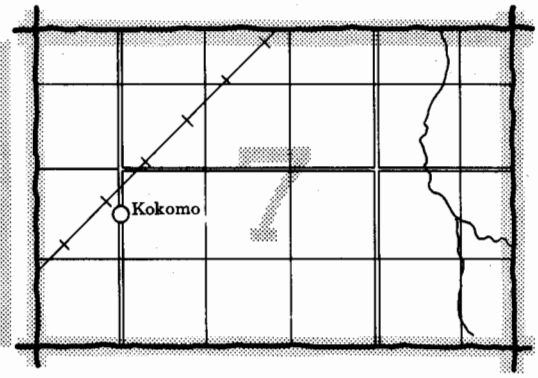

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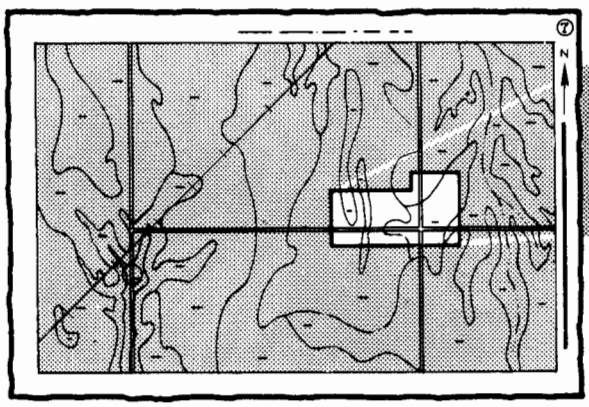
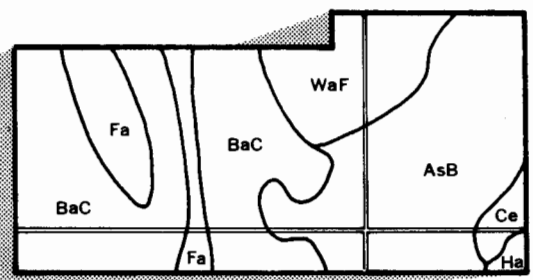
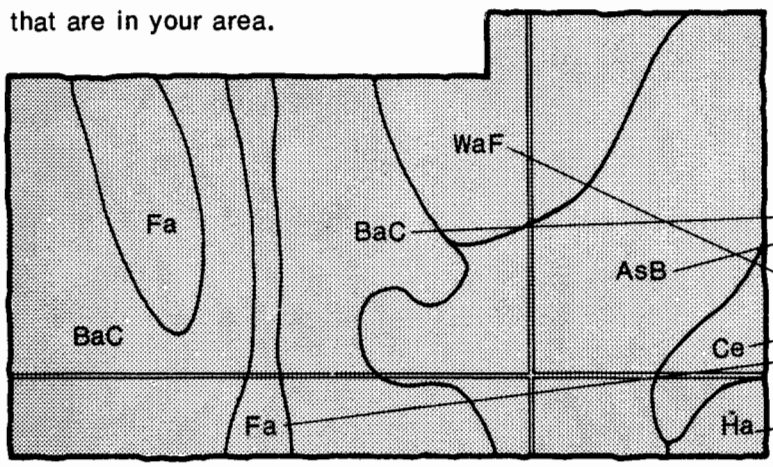




4. List the map unit symbols that are in your area.

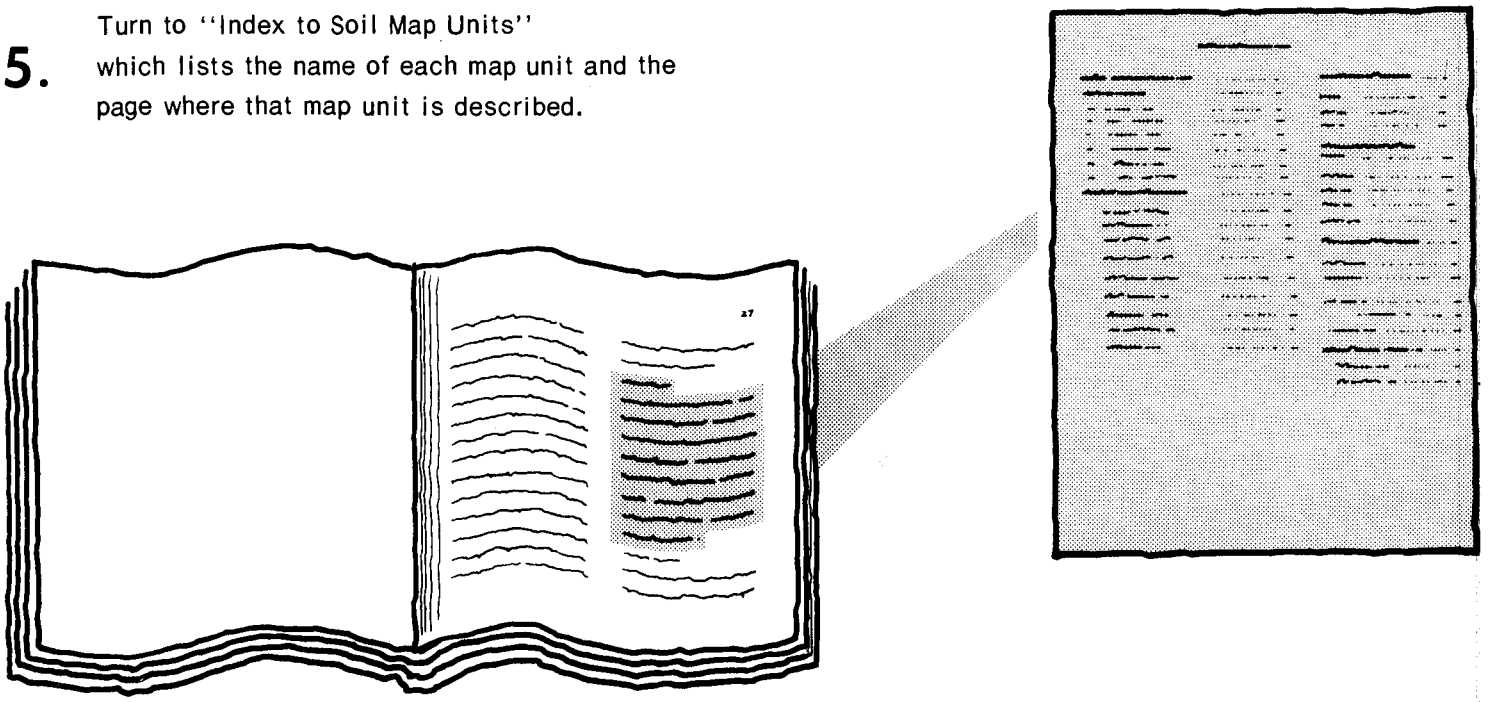


Symbols

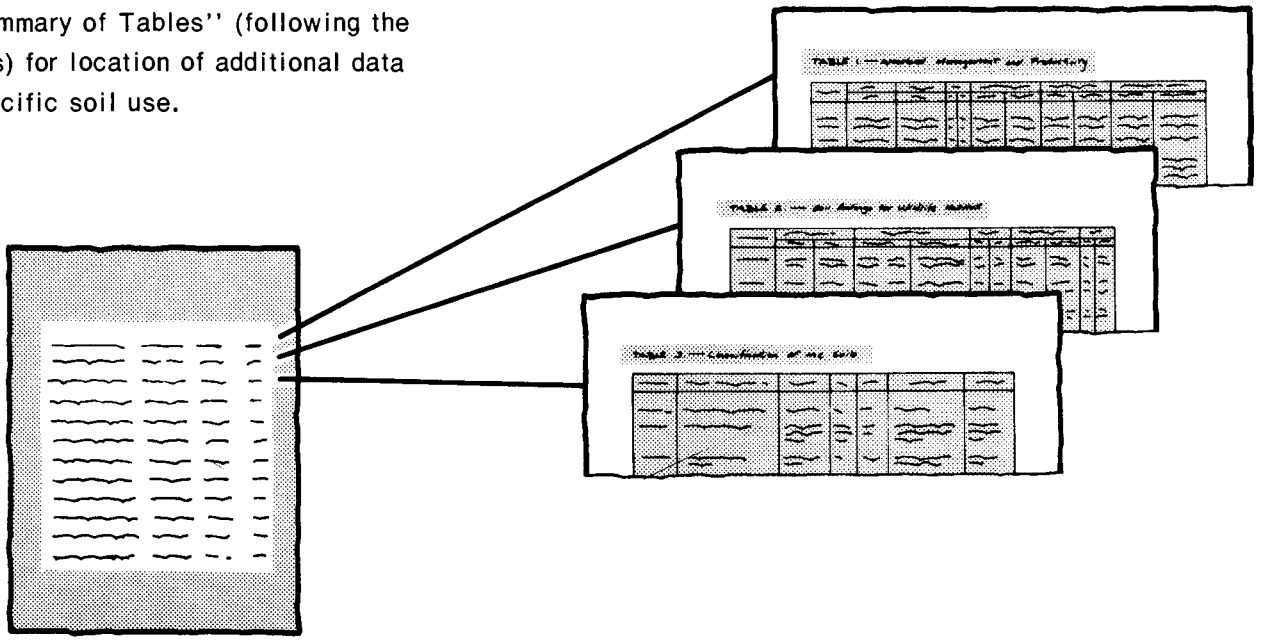
- AsB
- BaC
- Ce
- Fa
- Ha
- WaF

THIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural 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, handicap, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Marion Soil and Water Conservation District. Some of the funds for this survey were provided by the Marion County Commissioners.

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

Cover: Harvesting corn on Blount and Pewamo soils.

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Foreword

This soil survey contains information that can be used in land-planning programs in Marion County. 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 ensure 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 at the surface 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.

Joseph C. Branco
State Conservationist
Soil Conservation Service

Soil Survey of Marion County, Ohio

By K.E. Miller and N.H. Martin, Ohio Department of Natural Resources, Division of Soil and Water Conservation

Fieldwork by K.E. Miller, N.H. Martin, and N.A. Bonet, Ohio Department of Natural Resources, Division of Soil and Water Conservation

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

MARION COUNTY is in the north-central part of Ohio (fig. 1). It is on the drainage divide between the basin of the Great Lakes and the basin of the Ohio River. It has an area of 259,072 acres, or about 405 square miles. Marion, the county seat, is near the center of the county. In 1980, the population of the county was about 67,974 and the population of Marion was about 37,040 (*18*). The county has seven other incorporated villages and various unincorporated villages, old crossroad centers, and new subdivisions (*10*).

This soil survey updates the survey of Marion County published in 1916 (*11*). It is a detailed soil survey on aerial photography and gives more information about soil interpretations.

Figure 1.—Location of Marion County in Ohio.

General Nature of the County

The paragraphs that follow give general information about the county. They describe climate; agriculture; physiography, relief, and drainage; history and development; and geology.

Climate

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

Marion County is cold in winter and quite warm in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture by spring and thus minimizes drought on most soils. The normal annual precipitation is adequate for all of the crops that are suited to the temperature and growing season in the county.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Marion in the period 1951 to 1980. 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 27 degrees F, and the average daily minimum temperature is 19 degrees. The lowest temperature on record, which occurred at Marion on February 26, 1963, is -23 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred on July 2, 1966, is 101 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.

The total annual precipitation is about 34 inches. Of this, about 20 inches, or nearly 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15 inches. The heaviest 1-day rainfall during the period of record was 3.94 inches at Marion on July 10, 1969. Thunderstorms occur on about 40 days each year. Tornadoes and severe thunderstorms strike occasionally. These storms are usually local in extent and of short duration and cause damage in scattered small areas.

The average seasonal snowfall is about 26 inches. The greatest snow depth at any one time during the period of record was 18 inches. On the average, 25 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 70 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 60 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 13 miles per hour, in winter.

Agriculture

Marion County is an important agricultural area. In 1982, about 83 percent of the acreage in the county was farmland (*5*). The main enterprises are cash-grain farming and some livestock production and dairying. The main crops are soybeans, corn, and winter wheat.

Most of the soils in the county are well suited to field crops and pasture. Wetness is the main limitation. In most areas of farmland, a drainage system has been installed to improve crop production. The hazard of erosion generally is severe on the sloping and moderately steep soils on end moraines and along stream valleys. A large area west of Marion is subject to flooding.

The county had 890 farms in 1982. The trend in recent years has been a decrease in the number of farms and a slight increase in the average size. The average size is about 242 acres (*5*). Most farms range from 50 to 500 acres in size, although some are smaller than 10 acres and a few are more than 2,000 acres.

In recent years there has been a slight increase in the total acreage of cropland and a corresponding decrease in the acreage of woodland and pasture. The acreage used for soybeans has steadily increased, whereas that of other crops has slightly decreased. The number of farms that raise livestock has decreased. The number of all kinds of livestock, except for hogs and pigs, also has decreased. Numerous farms have no livestock (*4, 5*).

Physiography, Relief, and Drainage

Marion County lies wholly within the Scioto Lobe of the Indiana-Ohio Till Plain (*6*). The surface features include gently sloping hills, a few moderately steep valley sides, and extensive nearly level plains and basins. The topographic features are generally uniform. They are characterized by a relief of only about 235 feet. The main areas of considerable relief are in the valleys of the Scioto and Olentangy Rivers and along Tymochtee Creek. The highest elevation is about 1,105 feet above sea level. It is in Tully Township. The lowest elevation is about 870 feet. It is in Grand Township.

The most extensive landforms in the county are broad, nearly level ground moraines. The St. Johns and the Wabash end moraines are less extensive. They occur as low ridges. Two small glacial lake plains are in the western half of the county.

In the northwestern part of the county, surface water drains into Tymochtee Creek and the Little Sandusky River and then flows northward into Lake Erie. The rest of the county, which is separated from the northwestern part by the Wabash moraine, is drained by the Scioto, Little Scioto, and Olentangy Rivers and their tributaries. These streams flow southward.

History and Development

The first permanent settlements in Marion County were established south of Waldo in 1806. Settlement was prohibited in much of the county by the Greenville Treaty. In 1817, a treaty opened much of the territory north of the Greenville Treaty Line to settlement (*9*).

In 1820, the state legislature determined the boundaries of the county. The original county included parts of the present Wyandot, Crawford, and Morrow Counties. The present boundaries were established in

1848. The county was named after General Francis Marion, who had fought in the Revolutionary War (*9*).

Marion was chosen as the county seat in 1822. It has been the center of industrial, commercial, and residential development in the county (*9*).

Geology

The oldest rocks in Marion County belong to the Silurian system. They are in the western part of the county. They date from about 435 million years ago, when most of Ohio was covered by shallow oceans. During this period, only the simplest and lowest forms of plant life were in existence, but the seas contained many forms of marine life. Both the Niagra series and the overlying Cayugan series are in the western half of the county. They consist primarily of dolomite and a few shales or shaly dolmites (*13*).

Bedrock of the Devonian system underlies the eastern half of the county. The oldest rocks in this system formed during a period of deeper seas, which were inhabited by great numbers of fishes as well as the previously established forms of marine life. These rocks are exposed in quarries as the Columbus and Delaware limestones, mainly in the central townships of the county. As the seas became more shallow during this period, muddy sediments were deposited along the eastern edge of the county. The Olentangy shales and the overlying Ohio shales along the Olentangy River are from this period (*13*).

During the Pleistocene epoch of the Cenozoic Era, the survey area was covered by large continental glaciers. The most recent of these was the Wisconsin Glaciation (*6*). This glacier covered the entire survey area, scouring any deposits of earlier glaciers and completely covering them. The drift deposited by these glaciers is made up of unsorted rock debris, or till, and deposits of stratified sand and gravel.

When the melting front of the glacier remained stationary for a considerable period, a thick mass of glacial drift, or an end moraine, was formed along the front edge of the ice. These areas are expressed topographically as the low ridges of the Wabash and St. Johns end moraines. The part of the Wabash end moraine in Marion County extends from an area on the western boundary directly north of the Scotio River to Brush Ridge. The part of the St. Johns end moraine in the county extends from the southwest corner to an area on the northern boundary north of Kirkpatrick. On either side of the end moraines are flatter areas, called ground moraines.

In two areas of the county, shallow glacial lakes formed after the Wisconsin ice sheet retreated. They formed as a result of glacial moraine blockage of the natural drainage. Silty and clayey sediments that washed in from the surrounding areas built up at the bottom of these lakes. After the lake water receded, soils formed in these sediments. These soils are high in content of clay. One of these areas is west of Marion. It surrounds the Big Island Wildlife Area. The other glacial lake area is northwest of Big Island and west of Morral (*7*).

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of

horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

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 or 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 soil 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 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 the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another 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

Soils on Till Plains

These soils make up about 69 percent of the county. The moderately well drained, somewhat poorly drained, and very poorly drained, nearly level to moderately steep soils formed in glacial till. They are dominantly on broad flats and in undulating areas. Some areas along drainageways are slightly dissected. The soils are used mainly as cropland. Seasonal wetness, ponding, slow or moderately slow permeability, a moderate shrink-swell potential, and the hazard of erosion are the major management concerns.

1. Blount-Pewamo Association

Deep, nearly level and gently sloping, somewhat poorly drained and very poorly drained soils formed in glacial till

This association is on ground moraines and end moraines. The landscape is characterized by relatively broad flats, low knolls and ridges, depressions, and narrow drainageways. Most areas are drained by small streams and ditches. Slope ranges from 0 to 6 percent.

This association makes up about 56 percent of the county. It is about 45 percent Blount soils, 30 percent Pewamo soils, and 25 percent minor soils (fig. 2).

Blount soils are nearly level and gently sloping and are somewhat poorly drained. They are on slight rises and in hummocky or slightly dissected areas. Their surface layer is silt loam. A water table is in the upper part of the subsoil during extended wet periods. Permeability is slow or moderately slow. The organic matter content is moderate.

Pewamo soils are nearly level and very poorly drained. They are on flats, in depressions, and along drainageways. Their surface layer is silty clay loam. A water table is near or above the surface during extended wet periods. Permeability is moderately slow. The organic matter content is high.

Minor in this association are the Glynwood, Nolin, Sloan, Sleeth, and Whitaker soils. The moderately well drained Glynwood soils are on knolls and ridges and in slightly dissected areas adjacent to drainageways. Nolin and Sloan soils formed in alluvium on narrow flood plains along small streams. Sleeth and Whitaker soils have underlying material that is coarser textured than that of the major soils. They are on terraces along small streams.

Most areas of this association are used for corn, soybeans, or winter wheat. A few are used as pasture or woodland. Major soils are well suited to crops. Seasonal wetness is the major limitation affecting farm uses. Ponding is common on the Pewamo soils during extended wet periods and after heavy rains. The gently sloping Blount soils are susceptible to erosion. Measures that improve or maintain drainage systems, control erosion, and minimize crusting and compaction are needed.

The major soils are moderately well suited or poorly suited to buildings and are poorly suited to septic tank absorption fields. The main management concerns are ponding on the Pewamo soils, seasonal wetness in the Blount soils, and the restricted permeability of both soils.

2. Glynwood-Blount Association

Deep, nearly level to moderately steep, moderately well drained and somewhat poorly drained soils formed in glacial till

This association is on end moraines and on the dissected parts of ground moraines. The landscape is characterized by irregular slopes. Most areas are drained by numerous small drainageways. Slope is typically 0 to 6 percent but ranges from 0 to 18 percent.

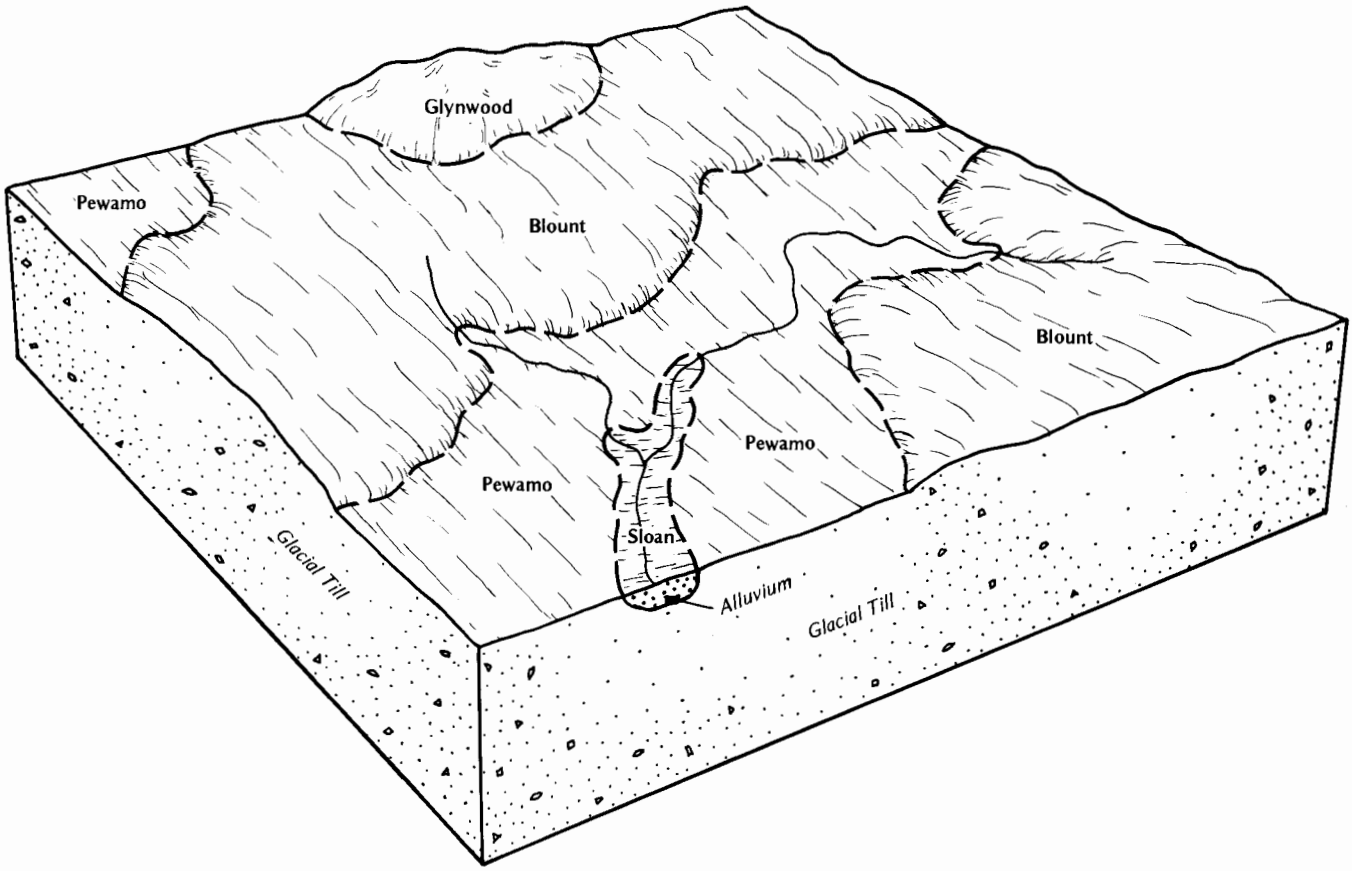

Figure 2.—Typical pattern of soils and parent material in the Blount-Pewamo association.

This association makes up about 7 percent of the county. It is about 60 percent Glynwood soils, 20 percent Blount soils, and 20 percent minor soils.

Glynwood soils are nearly level to moderately steep and are moderately well drained. They are on slight rises and on side slopes in hummocky or dissected areas. Their surface layer is silt loam. A water table is in the lower part of the subsoil during extended wet periods. Permeability is slow. The organic matter content is moderate or moderately low.

Blount soils are nearly level and gently sloping and are somewhat poorly drained. They are on slight rises and in hummocky or dissected areas. Their surface layer is silt loam. A water table is in the upper part of the subsoil during extended wet periods. Permeability is slow or moderately slow. The organic matter content is moderate.

Minor in this association are the Milton, Kendallville, Pewamo, Milford, and Sloan soils. The well drained Milton soils are in landscape positions similar to those of the Glynwood soils. They have limestone bedrock at a depth of 20 to 40 inches. The well drained Kendallville soils are on knolls and ridges adjacent to small streams. The very poorly drained Pewamo and Milford soils are in depressions and along drainageways. The very poorly drained Sloan soils are on flood plains along small streams.

Most areas of this association are used for corn, soybeans, or winter wheat. Some are used as building sites. The nearly level and gently sloping soils are well suited to crops, but the sloping and moderately steep soils are poorly suited. The seasonal wetness, the slope, and the hazard of erosion are the main problems affecting farm uses. Measures that maintain tilth and minimize crusting are needed.

The nearly level and gently sloping soils are well suited or moderately well suited to buildings and are moderately well suited or poorly suited to septic tank absorption fields. The sloping and moderately steep soils are moderately well suited or poorly suited to buildings and are poorly suited to septic tank absorption fields. The main management concerns are the wetness, the slope, a moderate shrink-swell potential, and the restricted permeability.

3. Pewamo-Elliott Association

Deep, nearly level, very poorly drained and somewhat poorly drained soils formed in glacial till

This association is on ground moraines. The landscape is characterized by broad flats and by slight rises, depressions, and drainageways. Most areas are drained by ditches and by subsurface drains. Slope ranges from 0 to 3 percent.

This association makes up about 2 percent of the county. It is about 65 percent Pewamo soils, 20 percent Elliott soils, and 15 percent minor soils.

Pewamo soils are very poorly drained. They are on flats, in depressions, and along drainageways. Their surface layer is silty clay loam. A water table is near or above the surface during extended wet periods. Permeability is moderately slow. The organic matter content is high.

Elliott soils are somewhat poorly drained. They are on slight rises. Their surface layer is silty clay loam. A water table is in the upper part of the subsoil during extended wet periods. Permeability is moderately slow or slow. The organic matter content is high.

Minor in this association are the Muskego and Whitaker soils. Muskego soils are mucky in the upper part. They are in depressions. Whitaker soils have a surface layer that is lighter colored than that of the major soils. They are on slight rises.

This association is used extensively as cropland. Corn, soybeans, and winter wheat are the main crops. The major soils are well suited to crops. Seasonal wetness is the major limitation affecting farm uses. Ponding is common on the Pewamo soils during extended wet periods and after heavy rains. Measures that improve or maintain drainage systems and minimize compaction are needed.

The major soils are poorly suited or moderately well suited to buildings and are poorly suited to septic tank absorption fields. The main management concerns are seasonal wetness in the Elliott soils, ponding on the Pewamo soils, and the restricted permeability of both soils.

4. Bennington-Pewamo-Cardington Association

Deep, nearly level to sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in glacial till

This association is on ground moraines. The landscape is gently undulating and is dissected along small streams. Somes areas have shallow depressions. Most are drained by small streams. Slope ranges from 0 to 12 percent.

This association makes up about 4 percent of the county. It is about 50 percent Bennington soils, 20 percent Pewamo soils, 15 percent Cardington soils, and 15 percent minor soils.

Bennington soils are nearly level and somewhat poorly drained. They are on slight rises and in slightly dissected areas. Their surface layer is silt loam. A water table is in the upper part of the subsoil during extended wet periods. Permeability is slow. The organic matter content is moderate.

Pewamo soils are nearly level and very poorly drained. They are in depressions and along drainageways. Their surface layer is silty clay loam. A water table is near or above the surface during extended wet periods. Permeability is moderately slow. The organic matter content is high.

Cardington soils are gently sloping and sloping and are moderately well drained. They are in hummocky or dissected areas. Their surface layer is silt loam. A water table is in the lower part of the subsoil during extended wet periods. Permeability is moderately slow. The organic matter content is moderate or moderately low.

Minor in this association are the Nolin, Newark, Ockley, Westland, and Whitaker soils. Nolin and Newark soils formed in alluvium on flood plains along small streams. Ockley, Westland, and Whitaker soils have more sand in the underlying material than the major soils. They are on terraces.

Most areas of this association are used as cropland. Corn, soybeans, and winter wheat are the major crops. Some areas are used as pasture or woodland. The nearly level and gently sloping soils are well suited to crops, but the sloping soils are poorly suited. Seasonal wetness and the hazard of erosion are the main problems affecting farm uses. Ponding is common on the Pewamo soils during extended wet periods and after heavy rains. Measures that control erosion, improve or maintain drainage systems, and maintain tilth are needed.

The Cardington soils are better suited to buildings than the Blount and Pewamo soils. The three soils are moderately well suited or poorly suited to septic tank absorption fields. The main management concerns are the seasonal wetness of the Bennington and Cardington soils, the ponding on the Pewamo soils, and the shrink-swell potential and restricted permeability of all three soils.

Soils on Lake Plains and Till Plains

These soils make up about 7 percent of the county. The moderately well drained and very poorly drained, nearly level and gently sloping soils formed in lacustrine sediments and glacial till. They are dominantly on broad flats and in undulating areas. They are used mainly as cropland. Ponding, seasonal wetness, moderately slow permeability, a moderate shrink-swell potential, and the hazard of erosion are the major management concerns.

5. Milford-Centerburg Association

Deep, nearly level and gently sloping, very poorly

drained and moderately well drained soils formed in lacustrine sediments and glacial till

This association is on broad lake plains and moraines. The landscape is characterized by broad flats and by drainageways, depressions, slight rises, and gently sloping knolls and ridges. Most areas are drained by small streams. Slope ranges from 0 to 4 percent.

This association makes up about 7 percent of the county. It is about 60 percent Milford soils, 20 percent Centerburg soils, and 20 percent minor soils.

Milford soils are nearly level and very poorly drained. They are on broad flats, in shallow depressions, and along drainageways. Their surface layer is silty clay loam. A water table is near or above the surface during extended wet periods. Permeability is moderately slow. The organic matter content is high.

Centerburg soils are gently sloping and moderately well drained. They are in hummocky or dissected areas. Their surface layer is silt loam. A water table is in the lower part of the subsoil during extended wet periods. Permeability is moderately slow. The organic matter content is moderate.

Minor in this association are the somewhat poorly drained Bennington and Elliott soils on low knolls; Muskego soils, which are mucky in the upper part and are in depressions; and the very poorly drained Sloan soils, which formed in alluvium on flood plains along small streams.

This association is used extensively as cropland. Corn, soybeans, and winter wheat are the major crops. The major soils are well suited to crops. Seasonal wetness and the erosion hazard are the main management concerns. The Milford soils are subject to ponding during extended wet periods and after heavy rains. Measures that control erosion on the Centerburg soils, improve or maintain drainage systems on the Milford soils, and maintain the tilth of both soils are needed.

The Centerburg soils are better suited to buildings and septic tank absorption fields than the Milford soils. The main management concerns are ponding on the Milford soils, seasonal wetness in the Centerburg soils, and the restricted permeability and shrink-swell potential of both soils.

Soils on Lake Plains

These soils make up about 17 percent of the county. The moderately well drained, somewhat poorly drained, and very poorly drained, nearly level to sloping soils formed in lacustrine sediments. They are dominantly on broad flats and in undulating areas. They are used mainly as cropland. Ponding, seasonal wetness, moderately slow to very slow permeability, a high shrink-swell potential, and the hazard of erosion are the major management concerns.

6. Milford-Del Rey-Shinrock Association

Deep, nearly level to sloping, very poorly drained, somewhat poorly drained, and moderately well drained soils formed in lacustrine sediments

This association is on extensive plains in former glacial lake basins. The landscape is characterized by broad flats and by depressions, drainageways, slight rises, and low knolls and ridges. Some areas are dissected by small streams. Most are drained by the small streams. Slope ranges from 0 to 12 percent.

This association makes up about 12 percent of the county. It is about 55 percent Milford soils, 15 percent Del Rey soils, 10 percent Shinrock soils, and 20 percent minor soils (fig. 3).

Milford soils are nearly level and very poorly drained. They are on broad flats, in shallow depressions, and along drainageways. Their surface layer is silty clay loam. A water table is near or above the surface during extended wet periods. Permeability is moderately slow. The organic matter content is high.

Del Rey soils are nearly level and somewhat poorly drained. They are on low knolls and ridges in slightly dissected areas. Their surface layer is silt loam. A water table is in the upper part of the subsoil during extended wet periods. Permeability is slow. The organic matter content is moderate.

Shinrock soils are gently sloping and sloping and are moderately well drained. They are on knolls, on ridges, and in dissected areas. Their surface layer is silt loam. A water table is in the lower part of the subsoil during extended wet periods. Permeability is moderately slow. The organic matter content is moderate or moderately low.

Minor in this association are the Blount, Fulton, Martinsville, Saranac, and Whitaker soils. Blount and Fulton soils are on slight rises. Blount soils have a higher content of coarse fragments in the lower part than the major soils. Fulton soils have more clay in the subsoil than the major soils. Martinsville and Whitaker soils have more sand in the underlying material than the major soils. They are on slight rises, low knolls, and ridges. Saranac soils formed in alluvium on flood plains along small streams.

This association is used extensively as cropland. Corn, soybeans, and winter wheat are the major crops. The nearly level and gently sloping soils are well suited to crops, but the sloping soils are poorly suited. Seasonal wetness and the hazard of erosion are the main management concerns. Ponding is common on Milford soils after heavy rains and during extended wet periods. Measures that control erosion on the Shinrock soils, improve or maintain drainage systems on the Milford and Del Rey soils, and maintain the tilth of all three soils are needed.

The Shinrock and Del Rey soils are better suited to buildings than the Milford soils. The three soils are

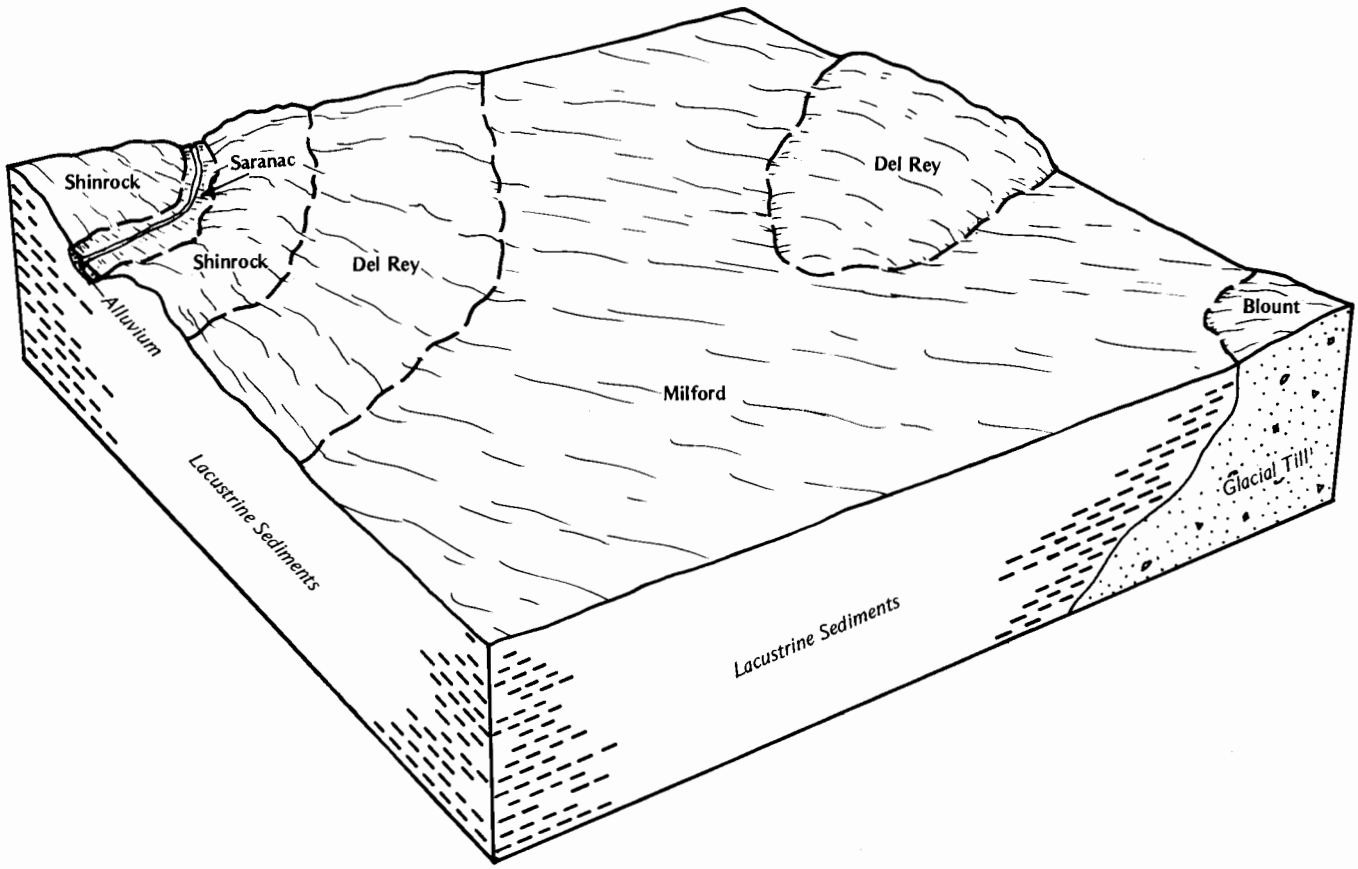

Figure 3.—Typical pattern of soils and parent material in the Milford-Del Rey-Shinrock association.

poorly suited or moderately well suited to septic tank absorption fields. The main management concerns are seasonal wetness in the Del Rey and Shinrock soils, ponding on the Milford soils, and the shrink-swell potential and restricted permeability of all three soils.

7. Latty-Fulton-Paulding Association

Deep, nearly level and gently sloping, very poorly drained and somewhat poorly drained soils formed in lacustrine sediments

This association is on broad plains in former glacial lake basins. The landscape is characterized by broad flats and by slight rises and slightly elevated knolls. Most areas are drained by ditches. Slope ranges from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 60 percent Latty soils, 20 percent Fulton soils, 15 percent Paulding soils, and 5 percent minor soils.

Latty and Paulding soils are nearly level and very poorly drained. They are on extensive flats. The Latty soils have a surface layer of silty clay, and the Paulding soils have one of clay. Both soils have a water table near or above the surface during extended wet periods. They are very slowly permeable. The organic matter content is moderate.

Fulton soils are nearly level and gently sloping and are somewhat poorly drained. They are on slight rises and on the hummocky and dissected parts of the lake plains. Their surface layer is silty clay loam. A water table is in the upper part of the subsoil during extended wet periods. Permeability is slow or very slow. The organic matter content is moderate.

Minor in this association are the Blount, Del Rey, Milford, and Shinrock soils. These soils have less clay in the subsoil than the major soils. Blount and Del Rey soils are on low knolls. Milford soils are in depressions and along drainageways. Shinrock soils are on knolls and ridges.

Most areas of this association are used as cropland. Some are used as habitat for wildlife. The major soils are moderately well suited or poorly suited to crops. The Latty and Paulding soils are well suited to habitat for wetland wildlife. Seasonal wetness or ponding, a high

content of clay in the subsoil, and the slow or very slow permeability are the main limitations affecting farm uses. Also, erosion is a moderate hazard on the gently sloping Fulton soils. Measures that improve or maintain drainage systems and maintain tilth are needed.

The major soils are poorly suited or generally unsuited to buildings and septic tank absorption fields. The main management concerns are ponding on the Latty and Paulding soils, seasonal wetness in the Fulton soils, and the restricted permeability and shrink-swell potential of all three soils.

Soils on Flood Plains and Terraces

These soils make up about 7 percent of the county. The well drained and very poorly drained, nearly level to moderately steep soils formed in alluvium and glacial outwash on flood plains and terraces in valleys. The landscape is typically one of nearly level valley floors, side slopes, and nearly level and gently sloping benches. Some areas are dissected. The soils are used mainly as cropland or woodland. Flooding, wetness, ponding, slope, moderately slow permeability, and erosion are the major management concerns.

8. Saranac-Sloan-Westland Association

Deep, nearly level, very poorly drained soils formed in alluvium and glacial outwash

This association is in river valleys. The landscape is characterized by nearly level valley floors that are bounded by gentle slope breaks to the uplands. Slope is 0 to 2 percent.

This association makes up about 3 percent of the county. It is about 35 percent Saranac soils, 15 percent Sloan soils, 10 percent Westland soils, and 40 percent soils of minor extent.

Saranac soils are on flood plains. They are occasionally or frequently flooded. They have a surface layer of silty clay loam. A seasonal high water table is near the surface. Permeability is moderately slow. The organic matter content is high.

Sloan soils are on flood plains. They are occasionally flooded. They have a surface layer of silty clay loam. A seasonal high water table is near the surface. Permeability is moderate or moderately slow. The organic matter content is high.

Westland soils are on stream terraces. They have a surface layer of clay loam. A seasonal high water table is near or above the surface. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic matter content is high.

Minor in this association are the somewhat poorly drained Sleeth and Whitaker soils, the moderately well drained Medway soils, and the well drained Martinsville soils. All of these soils are on slightly elevated terraces.

This association is used extensively as cropland. Corn, soybeans, and wheat are the main crops. The major soils generally are well suited to crops, but the frequently flooded, undrained areas of Saranac soils are generally unsuited. Flooding and seasonal wetness are the main problems affecting farming. Ponding is common on the Westland soils during wet periods and after heavy rains. Measures that improve or maintain drainage systems are needed. In many areas adequate drainage outlets are not available or are ineffective when flooding occurs.

The major soils are poorly suited or generally unsuited to buildings and septic tank absorption fields. The main management concerns are the flooding, seasonal wetness, and restricted permeability in areas of the Saranac and Sloan soils and the ponding on the Westland soils.

9. Nolin-Kendallville-Ockley Association

Deep, nearly level to moderately steep, well drained soils formed in alluvium and glacial outwash

This association is in stream valleys. The landscape is one of nearly level valley floors, side slopes, and terrace benches. Slope is typically 0 to 6 percent but ranges from 0 to 18 percent in dissected areas.

This association makes up about 4 percent of the county. It is about 25 percent Nolin soils, 15 percent Kendallville soils, 10 percent Ockley soils, and 50 percent minor soils.

Nolin soils are nearly level and are on flood plains. They are occasionally flooded. Their surface layer is silt loam. Permeability is moderate. The organic matter content also is moderate.

Kendallville soils are gently sloping to moderately steep. They are on terraces adjacent to the uplands and on side slopes in dissected areas. Their surface layer is loam. Permeability is moderately slow. The organic matter content is moderate.

Ockley soils are nearly level and gently sloping. They are on terrace benches above the flood plains. Their surface layer is loam. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic matter content is moderate.

Minor in this association are the Sloan, Newark, Medway, Sleeth, Fox, and Glynwood soils. The very poorly drained Sloan and somewhat poorly drained Newark soils are on flood plains. The moderately well drained Medway and somewhat poorly drained Sleeth soils are on low stream terraces. Fox soils are more droughty than the major soils. They are on terraces. The moderately well drained Glynwood soils are on side slopes in the uplands.

Most areas of this association are used for corn, soybeans, or winter wheat. Some are used as woodland. The nearly level and gently sloping soils are well suited or moderately well suited to crops. The steeper soils are poorly suited to most uses, except for woodland and wildlife habitat. The hazard of flooding, the slope, and the hazard of erosion are the main problems affecting

farm uses. The Nolin soils are occasionally flooded during the growing season.

The Nolin soils are generally unsuited to buildings and septic tank absorption fields, and the less sloping Kendallville and Ockley soils are well suited to buildings and moderately well suited or well suited to septic tank absorption fields. The main management concerns are the flooding on the Nolin soils and the slope and restricted permeability of the Kendallville soils.

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 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, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Glynwood silt loam, 2 to 6 percent slopes, is a phase of the Glynwood series.

Some map units are made up to two or more major soils or of one soil and a miscellaneous area. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, 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. The Pewamo-Urban land complex is an example.

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

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

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

Soil Descriptions

BgA—Bennington silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is in slightly dissected areas on ground moraines. Most areas are irregularly shaped and range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown and brown, mottled, firm silty clay loam, and the lower part is yellowish brown and dark yellowish brown, mottled, firm and friable clay loam. The underlying material to a depth of about 60 inches is brown and yellowish brown, mottled, calcareous, firm loam and clay loam glacial till. In some areas the subsoil is silt loam or loam to a depth of 2 or 3 feet. In a few areas the soil is poorly drained.

Included with this soil in mapping are small areas of Cardington, Milford, and Pewamo soils. The moderately well drained Cardington soils are on low knolls in some hummocky areas. The very poorly drained Milford and Pewamo soils are along drainageways and in depressions. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Bennington soil. Available water capacity is moderate. Runoff is slow or medium. Tilth is generally good unless the soil is tilled when wet. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 1.0 to 2.5 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness is the main management concern. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to dwellings and recreational areas and is poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIw. The woodland ordination symbol is 4A.

BoA—Blount silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises on ground moraines and end moraines (fig. 4). Most areas are irregularly shaped and range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The subsoil is about 21 inches thick. The upper part is brown and grayish brown, mottled, firm silty clay, and the lower part is yellowish brown and brown, mottled, firm silty clay and silty clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm clay loam glacial till. In some areas the subsoil contains less clay. In a few areas the subsoil is thicker and has a thin layer of silt loam or loam in the lower part. In a few places the surface layer is loam or silty clay loam. In some areas the soil is poorly drained.

Included with this soil in mapping are small areas of Glynwood and Pewamo soils. The moderately well drained Glynwood soils are in some hummocky areas. The very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 10 percent of most mapped areas.

Permeability is slow or moderately slow in the Blount soil. Available water capacity is moderate. Runoff is slow. Tilth is generally good unless the soil is tilled when wet. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 1 to 3 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans (fig. 5), small grain, hay, and pasture. The seasonal wetness is the main management concern. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. Deepening outlet ditches improves the effectiveness of the subsurface drainage system. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard.

This soil is moderately well suited to dwellings and recreational areas and is poorly suited to septic tank absorption fields. The wetness and the slow or moderately slow permeability are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Figure 4.—An area of Blount silt loam, 0 to 2 percent slopes, on slight rises. The dark Pewamo soils are in the background.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed. The soil is well suited to ponds.

The land capability classification is IIw. The woodland ordination symbol is 3C.

BoB—Blount silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is in hummocky or slightly dissected areas on ground moraines and end moraines. Most areas are irregularly shaped and range from 10 to 200 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 15 inches thick. The upper part is yellowish brown, mottled, firm clay loam, and the lower part is brown and grayish brown, mottled, firm clay and clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm clay loam glacial till. In some areas the subsoil contains less clay. In a few areas the surface layer is eroded.

Included with this soil in mapping are small areas of Glynwood and Pewamo soils. The moderately well drained Glynwood soils are in some hummocky areas. The very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 10 percent of most mapped areas.

Permeability is slow or moderately slow in the Blount soil. Available water capacity is moderate. Runoff is medium. Tilth is generally good unless the soil is tilled when wet. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 1 to 3 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. Erosion and seasonal wetness are the main management concerns. A subsurface drainage system helps to lower

Figure 5.—Soybeans on Blount silt loam, 0 to 2 percent slopes.

the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard.

This soil is moderately well suited to dwellings and recreational areas and is poorly suited to septic tank absorption fields. The wetness and the slow or moderately slow permeability are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is IIe. The woodland ordination symbol is 3C.

BuB—Blount-Urban land complex, undulating. This map unit consists of a deep, somewhat poorly drained Blount soil and areas of Urban land. The unit is in hummocky or slightly dissected areas on ground moraines and end moraines. Slope ranges from 2 to 6 percent. Most areas range from 10 to several hundred acres in size. They are about 50 percent Blount silt loam and 35 percent Urban land. The Blount soil and the Urban land occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Blount soil has a surface layer of brown, friable silt loam about 10 inches thick. The subsoil is about 15 inches thick. The upper part is yellowish brown, mottled, firm clay loam, and the lower part is brown and grayish brown, mottled, firm clay and clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm clay loam glacial till. In places the soil has been radically altered. Some of the low areas have been filled or leveled during construction, and other small areas have been cut, built up, or smoothed. In a few areas the soil is poorly drained. In places the subsoil contains less clay.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible. Moderately alkaline clay loam or silty clay loam glacial till commonly underlies the Urban land.

Included in this unit in mapping are small areas of Glynwood and Pewamo soils. The moderately well drained Glynwood soils are on low knolls and side slopes. The very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 15 percent of most mapped areas.

Most areas of this map unit are drained by sewer systems, gutters, and subsurface drains. In undrained areas of the Blount soil, a perched seasonal high water table is at a depth of 1 to 3 feet during extended wet periods. Permeability in this soil is slow or moderately slow. Available water capacity is moderate. Runoff is medium. Tilth is generally good. The surface layer has a moderate organic matter content. The potential for frost action is high.

The Blount soil is used for parks, open areas, lawns, and gardens. It is well suited to grasses, trees and shrubs, and flower and vegetable gardens. Seasonal wetness and erosion are the main limitations affecting these uses. The surface layer clods if worked when wet. Subsurface drains remove excess water. The perennials selected for planting should be those that are tolerant of wetness. Erosion is a problem in disturbed areas where the surface is bare. In radically altered areas, the soil is not so well suited to lawns and gardens. Tilth is very poor if the subsoil or underlying material is exposed in these areas. The exposed material is sticky when wet and hard when dry.

The Blount soil is moderately well suited to dwellings and recreational uses. The wetness is the main limitation affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action. Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

Most areas are served by sewers. The Blount soil is poorly suited to septic tank absorption fields because of the wetness and the slow or moderately slow permeability. Enlarging the absorption area helps to overcome the restricted permeability. Perimeter drains around the absorption field help to lower the seasonal high water table.

No land capability classification or woodland ordination symbol is assigned.

CdB—Cardington silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is in hummocky and slightly dissected areas on ground moraines. Most areas are irregularly shaped and range from 10 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 20 inches

thick. It is yellowish brown and dark yellowish brown, mottled, and firm. The upper part is silty clay loam, the next part is silty clay, and the lower part is clay loam. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, firm clay loam glacial till. In some areas the soil is well drained. In other areas the subsoil is loam or silt loam to a depth of 2 or 3 feet. In a few areas the surface layer is eroded.

Included with this soil in mapping are small areas of Bennington and Pewamo soils. The somewhat poorly drained Bennington soils are along drainageways and at the base of slopes. The very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Cardington soil. Available water capacity is moderate. Runoff is medium. Tilth is generally good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction. Random subsurface drains commonly are installed in the wetter included soils.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and moderately well suited to septic tank absorption fields. The wetness, the moderately slow permeability, and a moderate shrink-swell potential in the subsoil are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Strengthening foundation walls and concrete slabs and backfilling with material that has a low shrink-swell potential minimize the damage caused by shrinking and swelling. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIe. The woodland ordination symbol is 4A.

CdC2—Cardington silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on side slopes along drainageways and in dissected areas on ground moraines. Erosion has removed part of the original surface layer. Subsoil material with a higher content of clay has been mixed into the present surface layer. Most areas are long and narrow and range from 5 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 18 inches of yellowish brown and dark yellowish brown, mottled, firm silty clay loam and clay loam. The underlying material to a depth of about 60 inches is yellowish brown, calcareous, firm clay loam glacial till. In some areas the soil is well drained. In a few areas the surface layer is clay loam or silty clay loam.

Included with this soil in mapping are small seepy areas on side slopes. Also included are some areas where the slope is 12 to 20 percent and some severely eroded areas where tilth is poor. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Cardington soil. Available water capacity is moderate. Runoff is rapid. Tilth is generally good. The surface layer has a moderately low organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods.

This soil is used mainly as cropland. In some areas it is used as permanent pasture. It is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. It has resulted in a less productive soil that is more difficult to manage. No-till planting or another system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and helps to control erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

A cover of hay or pasture plants reduces the hazard of erosion. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to dwellings and poorly suited to septic tank absorption fields. The seasonal wetness, the slope, the moderately slow permeability, and a moderate shrink-swell potential are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. Foundation walls should be reinforced and should be backfilled with material that has a low shrink-swell potential. The backfill material should be porous enough for good drainage. The natural drainageways and the included seepy areas should not be selected as building sites. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table. Installing the distribution lines on the contour minimizes the seepage of effluent to the surface.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

CeB—Centerburg silt loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is in hummocky areas on ground moraines and end moraines. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is yellowish brown, dark yellowish brown, and brown, mottled, firm clay loam about 28 inches thick. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, firm loam glacial till. In some places the subsoil has more silt. In other places the soil is well drained. In some small areas it is eroded.

Included with this soil in mapping are small areas of Bennington, Martinsville, and Pewamo soils. The well drained Martinsville soils are on the slightly higher parts of knolls. The somewhat poorly drained Bennington and very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Centerburg soil. Available water capacity is moderate or high. Runoff is medium. Tilth is generally good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction. Random subsurface drains commonly are installed in the wetter included soils.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Competing vegetation is the main management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when seedlings are becoming established.

This soil is well suited to dwellings and moderately well suited to septic tank absorption fields. The wetness, the moderately slow permeability, and a moderate shrink-swell potential in the subsoil are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. The damage caused by shrinking and swelling can be minimized by strengthening foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field

help to lower the seasonal high water table. The included Martinsville soils, which are moderately permeable and well drained, are better suited to septic tank absorption fields.

The land capability classification is IIe. The woodland ordination symbol is 5A.

DeA—Del Rey silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is in slightly elevated areas on lake plains. Most areas are irregularly shaped and range from 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The subsoil is dark yellowish brown and yellowish brown, mottled, firm silty clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, friable, stratified silt loam and fine sandy loam. In some areas the subsoil has less clay. In a few places the underlying material is silt loam glacial till. In a few areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas of Milford and Shinrock soils. The very poorly drained Milford soils are along drainageways and in depressions. The moderately well drained Shinrock soils are in some hummocky areas. Also included are areas of soils that are subject to rare flooding. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Del Rey soil. Available water capacity is moderate. Runoff is slow or medium. Tilth is generally good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A seasonal high water table is at a depth of 1 to 3 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness is the main management concern. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard.

This soil is moderately well suited to dwellings and recreational areas and is poorly suited to septic tank absorption fields. The seasonal wetness and the slow permeability are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. The included soils that are subject to rare flooding should not be selected as sites for buildings. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is IIw. The woodland ordination symbol is 4C.

EtA—Elliott silty clay loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises on ground moraines. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, firm silty clay loam about 12 inches thick. The subsoil is about 25 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam, and the lower part is yellowish brown, mottled, firm silty clay loam and silty clay. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm clay loam glacial till. In many areas the subsoil has less clay. In a few areas the surface layer is dark brown or dark grayish brown silt loam.

Included with this soil in mapping are small areas of the very poorly drained Pewamo soils in depressions and moderately well drained soils on slight rises. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow or slow in the Elliott soil. Available water capacity is high. Runoff is slow. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high. A perched seasonal high water table is at a depth of 1 to 3 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. Seasonal wetness and soil compaction are the main management concerns. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. In some

areas drainage outlets for subsurface drains are blocked by high water. Deepening the outlet ditches improves the effectiveness of the subsurface drainage system. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

This soil is moderately well suited to dwellings and recreational areas and is poorly suited to septic tank absorption fields. The wetness and the slow or moderately slow permeability are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIw. No woodland ordination symbol is assigned.

FcA—Fitchville silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on stream terraces. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 33 inches of yellowish brown and brown, mottled, friable and firm silty clay loam and silt loam. The underlying material to a depth of about 60 inches is olive brown, mottled, friable, stratified silt loam and silty clay loam.

Included with this soil in mapping are small areas of the very poorly drained Milford and Sloan soils along drainageways and in depressions and small areas of moderately well drained soils on slight rises. Also included are areas of soils that are subject to rare flooding. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Fitchville soil. Available water capacity is high. Runoff is slow. The surface layer has a moderate organic matter content and crusts after hard rains. Tilth is generally good. The potential for frost action is high. A seasonal high water table is at a depth of 1.0 to 2.5 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness is the main management concern. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. In some areas drainage outlets are ineffective when the nearby rivers and streams flood. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to dwellings and septic tank absorption fields. The seasonal wetness and the moderately slow permeability are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. The included soils that are subject to rare flooding should not be selected as sites for buildings. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIw. The woodland ordination symbol is 5A.

FoA—Fox loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on stream terraces. Most areas are irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is brown, very friable loam about 10 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown and dark yellowish brown, firm clay loam, and the lower part is dark brown, friable sandy clay loam and very friable sandy loam. The underlying material to a depth of about 60 inches is

yellowish brown and dark grayish brown, loose sand. In some areas it is loamy coarse sand.

Included with this soil in mapping are small areas of Ockley and Sleeth soils. Ockley soils have a subsoil that is thicker than that of the Fox soil. They are along the periphery of most mapped areas. The somewhat poorly drained Sleeth soils are along drainageways and in depressions. Also included are areas of soils that are subject to rare flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the subsoil of the Fox soil and rapid or very rapid in the underlying material. Available water capacity is low or moderate. Runoff is slow. Tilth is good. The surface layer has a moderately low organic matter content. The root zone of most crops is limited mainly to the moderately deep zone above the underlying material.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, small grain, hay, and pasture. Because of droughtiness, it is better suited to crops that mature early in the growing season than to other crops. The soil dries out early in spring, and the plants often show evidence of moisture stress late in summer. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Returning crop residue to the soil and adding other organic material conserve moisture and improve tilth and fertility. The soil is well suited to irrigation. Plant nutrients are leached at a faster rate in this soil than in most other soils; consequently, plants generally respond better to smaller, more frequent or timely applications of fertilizer and lime than to one large application.

The pasture species selected for seeding should be those that are tolerant of the droughtiness. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and moderately well suited to septic tank absorption fields. A moderate shrink-swell potential and a poor filtering capacity are the main limitations affecting these uses. Extending the foundations of buildings without basements to the underlying material minimizes the damage caused by shrinking and swelling. Properly landscaping building sites helps to divert surface water away from foundations. The included soils that are subject to rare flooding should not be selected as building sites. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action. Sloughing is a hazard in shallow excavations.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the contamination of underground water supplies. Installing the absorption field in suitable fill material improves the filtering capacity.

The land capability classification is IIs. The woodland ordination symbol is 4A.

FoB—Fox loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil generally is on the hummocky or slightly dissected parts of stream terraces. In a few areas it is on moraines. Most areas are elongated or irregularly shaped and range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 8 inches thick. The subsoil is about 21 inches of dark brown, firm clay loam and gravelly clay loam. The underlying material to a depth of about 60 inches is brown and dark yellowish brown, loose gravelly and very gravelly coarse sand. In some areas small cobblestones are on the surface. In a few areas the underlying material is loamy coarse sand.

Included with this soil in mapping are small areas of Glynwood, Kendallville, and Ockley soils. Glynwood and Kendallville soils are underlain by glacial till. They are on low knolls and side slopes. Ockley soils have a subsoil that is thicker than that of the Fox soil. They are in the less sloping areas. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the subsoil of the Fox soil and rapid or very rapid in the underlying material. Available water capacity is low. Runoff is medium. Tilth is good. The surface layer has a moderately low organic matter content. The root zone of most crops is limited mainly to the moderately deep zone above the underlying material.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, small grain, hay, and pasture. Because of droughtiness, it is better suited to crops that mature early in the growing season than to other crops. Erosion and droughtiness are the main management concerns. The soil dries out early in spring, and the plants often show evidence of moisture stress late in summer.

No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material conserve moisture, minimize surface crusting, and improve tilth and fertility. The soil is well suited to irrigation. Plant nutrients are leached at a faster rate in this soil than in most other soils; consequently, plants generally respond better to

smaller, more frequent or timely applications of fertilizer and lime than to one large application.

The pasture species selected for seeding should be those that are tolerant of the droughtiness. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and moderately well suited to septic tank absorption fields. A moderate shrink-swell potential and a poor filtering capacity are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover. Extending the foundations of buildings without basements to the underlying material minimizes the damage caused by shrinking and swelling. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action. Sloughing is a hazard in shallow excavations.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the contamination of underground water supplies. Installing the absorption field in suitable fill material improves the filtering capacity.

The land capability classification is IIe. The woodland ordination symbol is 4A.

FtA—Fulton silty clay loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in slightly elevated areas on lake plains. Most areas are irregularly shaped and range from 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 10 inches thick. The subsoil is brown and dark yellowish brown, mottled, very firm silty clay about 27 inches thick. The underlying material to a depth of about 60 inches is brown and dark yellowish brown, mottled, very firm silty clay. It is lacustrine material. In a few areas the soil is underlain by clay loam glacial till at a depth of about 30 to 40 inches. In some areas, the upper part of the subsoil is silty clay loam and the surface layer is silt loam.

Included with this soil in mapping are small areas of Latty and Whitaker soils. The very poorly drained Latty soils are on broad flats. Whitaker soils have more sand throughout than the Fulton soil. They are on stream terraces. Also included are areas of soils that are subject to rare flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is slow or very slow in the Fulton soil. Available water capacity is moderate. Runoff is slow. Tilth is fair. The surface layer has a moderate organic matter content and crusts after hard rains. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 1.0 to 2.5 feet during extended wet periods.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness and the high content of clay are the main management concerns. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. In some areas drainage outlets are ineffective when the nearby rivers and streams flood. Deepening the outlet ditches improves the effectiveness of the subsurface drainage system. A good drainage system is needed in areas where a no-till system of planting is applied. Fall tillage improves tilth in the spring. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard.

This soil is poorly suited to dwellings because of the wetness and the high shrink-swell potential. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. In some areas, however, good drainage outlets are not available. The backfill material around foundations should be porous enough for good drainage. The damage caused by shrinking and swelling can be minimized by strengthening foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields because of the seasonal wetness and the slow or very slow permeability. Enlarging the absorption area helps to overcome the restricted permeability. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIIw. The woodland ordination symbol is 4C.

FtB—Fulton silty clay loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil

is in hummocky or slightly dissected areas on lake plains. Most areas are oval or irregularly shaped and range from 15 to 30 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 8 inches thick. The subsoil is mottled silty clay about 21 inches thick. The upper part is light olive brown and firm, and the lower part is brown and dark yellowish brown and is firm and very firm. The underlying material to a depth of about 60 inches is light olive brown, mottled, very firm silty clay. It is lacustrine material. In some areas the surface layer is silt loam. In a few areas the subsoil has thin strata of silt loam. In places glacial till is at a depth of about 30 to 40 inches.

Included with this soil in mapping are small areas of Latty and Whitaker soils. The very poorly drained Latty soils are along drainageways and in depressions. Whitaker soils have more sand throughout than the Fulton soil. They are on stream terraces. Included soils make up about 10 percent of most mapped areas.

Permeability is slow or very slow in the Fulton soil. Available water capacity is moderate. Runoff is medium. Tilth is fair. The surface layer has a moderate organic matter content and crusts after hard rains. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 1.0 to 2.5 feet during extended wet periods.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, small grain, hay, and pasture. The hazard of erosion, the seasonal wetness, and the high content of clay are the main management concerns. A subsurface drainage system helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in the spring. A good drainage system is needed in areas where a no-till system of planting is applied. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting, improve tilth and fertility, and help to control erosion. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

The pasture species selected for seeding should be those that are tolerant of wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard.

This soil is poorly suited to dwellings because of the wetness and the high shrink-swell potential. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. The damage caused by shrinking and swelling can be minimized by strengthening foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields because of the wetness and the slow or very slow permeability. Enlarging the absorption area helps to overcome the restricted permeability. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

GwA—Glynwood silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on the undissected parts of ground moraines and end moraines. Most areas are irregularly shaped and range from 30 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 11 inches thick. The subsoil is about 16 inches thick. The upper part is yellowish brown, firm clay loam, and the lower part is dark yellowish brown, mottled, very firm clay and clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm clay loam glacial till. In some areas the soil is underlain by fractured limestone bedrock at a depth of 60 to 80 inches and is well drained.

Included with this soil in mapping are small areas of Blount and Milton soils. The somewhat poorly drained Blount soils are in depressions. The moderately deep Milton soils are in landscape positions similar to those of the Glynwood soil. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Glynwood soil. Available water capacity is moderate. Runoff is slow. Tilth is generally good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water is at a depth of 2.0 to 3.5 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. No-till planting or another system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing

during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and recreational uses and is moderately well suited to septic tank absorption fields. The wetness, the slow permeability, and a moderate shrink-swell potential are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is I. The woodland ordination symbol is 4C.

GwB—Glynwood silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is in hummocky or slightly dissected areas on ground moraines and end moraines. Most areas are irregularly shaped and range from 5 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 20 inches of dark yellowish brown and yellowish brown, mottled, firm and very firm silty clay and silty clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm clay loam glacial till. In a few areas the surface layer is eroded and is clay loam or silty clay loam.

Included with this soil in mapping are small areas of Blount, Milton, Ockley, and Pewamo soils. The somewhat poorly drained Blount soils are on the lower part of slopes, in depressions, and along drainageways. The moderately deep Milton soils are on slight rises and slope breaks. The well drained Ockley soils are on end moraines. The very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 15 percent of most mapped areas.

Permeability is slow in the Glynwood soil. Available water capacity is moderate. Runoff is medium. Tilth is generally good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and helps to control erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction. Random subsurface drains commonly are installed in the wetter included soils.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and recreational uses and is moderately well suited to septic tank absorption fields. The seasonal wetness, the slow permeability, and a moderate shrink-swell potential are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. The damage caused by shrinking and swelling can be minimized by strengthening foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is IIe. The woodland ordination symbol is 4C.

GwC2—Glynwood silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on side slopes on the dissected parts of ground moraines and end moraines. Erosion has removed part of the original surface layer. Subsoil material with a higher content of clay and of coarse fragments has been mixed into the present surface layer. Most areas are long and narrow and range from 10 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 19 inches thick. It is yellowish brown and mottled. The upper part is firm and friable clay loam, and the lower part is firm clay. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm clay loam glacial till. In some areas the soil is well drained. In a few areas the surface layer is clay loam or silty clay loam. In a few narrow strips, the slope is 12 to 20 percent.

Included with this soil in mapping are small seepy areas and a few severely eroded areas where tilth is poor. Included soils are on side slopes. They make up about 15 percent of most mapped areas.

Permeability is slow in the Glynwood soil. Available water capacity is moderate. Runoff is rapid. Tilth is generally good. The surface layer has a moderately low organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

This soil is used mainly as cropland. In some areas it is used as permanent pasture. It is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. It has resulted in a less productive soil that is more difficult to manage. No-till planting or another system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and helps to control erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

A cover of hay or pasture plants reduces the hazard of erosion. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to dwellings and poorly suited to septic tank absorption fields. The seasonal wetness, the slope, the slow permeability, and a moderate shrink-swell potential are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. Foundation walls should be reinforced and should be backfilled with material that has a low shrink-swell potential. The backfill material should be porous enough for good drainage. The natural drainageways and the included seepy areas should not be selected as building sites. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table. Installing the distribution lines on the contour minimizes the seepage of effluent to the surface.

The land capability classification is IVe. The woodland ordination symbol is 4C.

GwD2—Glynwood silt loam, 12 to 18 percent slopes, eroded. This deep, moderately steep, moderately well drained soil is on side slopes on the dissected parts of ground moraines and end moraines. Erosion has removed part of the original surface layer. Subsoil material with a higher content of clay has been mixed into the present surface layer. Most areas are long and narrow and range from 5 to 15 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown, mottled, friable and firm silt loam and silty clay loam, and the lower part is dark yellowish brown, mottled, firm clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm clay loam glacial till. In some areas the surface layer is clay loam or silty clay loam. In a few areas the soil is well drained.

Included with this soil in mapping are small areas where the slope is 18 to 40 percent, small seeps on side slopes, and some severely eroded areas where tilth is poor. Included soils make up about 10 percent of most mapped areas.

Permeability is slow in the Glynwood soil. Available water capacity is moderate. Runoff is very rapid. The surface layer has a moderately low organic matter content. The potential for frost action is high. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

This soil is poorly suited to cultivated crops. The hazard of erosion and the slope are the main management concerns. Erosion has resulted in a less productive soil that is more difficult to manage. The short, moderately steep slopes hinder the use of equipment and the application of some erosion-control measures. No-till planting or another system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and helps to control erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Grassed waterways can help to prevent gullying.

Some areas are used as permanent pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

Many areas are used as woodland. The moderately steep slope and the seedling mortality rate are management concerns. Erosion is a hazard along logging roads and skid trails. It can be controlled by water bars or a vegetative cover. Building logging roads in the less sloping areas facilitates the use of equipment. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to dwellings and septic tank absorption fields. The slope, the seasonal wetness, the slow permeability, and a moderate shrink-swell potential are the main limitations affecting these uses. Extensive land shaping generally is necessary. Stockpiling the surface layer and then spreading it during the final grading hasten reestablishment of the plant cover. Waterways should be protected against erosion by a cover of grasses or by stone riprap. Subsurface drains help to intercept laterally moving water in the seepy included areas. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. Foundation walls should be reinforced and should be backfilled with material that has a low shrink-swell potential.

Artificially draining this soil and strengthening or replacing the base material help to prevent the damage to local roads caused by low strength and frost action. Building on the contour helps to overcome the slope.

Installing the distribution lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. Enlarging the absorption area helps to overcome the restricted permeability. Installing cross-slope drains upslope from the absorption field reduces the seasonal wetness.

Many small watershed areas are suitable sites for ponds. Also, scenic areas are suited to some recreational uses.

The land capability classification is IVe. The woodland ordination symbol is 4R.

GzB—Glynwood-Urban land complex, undulating. This map unit consists of a deep, moderately well drained Glynwood soil and areas of Urban land. The unit is in slightly dissected areas on ground moraines and end moraines. Slope ranges from 2 to 6 percent. Most areas range from 10 to 200 acres in size. They are about 50 percent Glynwood silt loam and 35 percent Urban land. The Glynwood soil and the Urban land occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Glynwood soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is about 20 inches of dark yellowish brown and yellowish brown, mottled, firm and very firm silty clay and silty clay loam. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm clay loam glacial till. In places the soil has been radically altered. Some of the low areas have been filled or leveled during construction, and other small areas have been cut, built up, or smoothed. In some areas the lower part of the underlying material has thin strata of silt loam.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible. Moderately alkaline clay loam or silty clay loam glacial till commonly underlies the Urban land.

Included in this unit in mapping are small areas of Blount, Milton, and Pewamo soils. The somewhat poorly drained Blount and very poorly drained Pewamo soils are along drainageways and in depressions. The moderately deep Milton soils are intermingled with areas of the Glynwood soil. Included soils make up about 15 percent of most mapped areas.

Most areas of this map unit are drained by sewer systems, gutters, and subsurface drains. In undrained areas of the Glynwood soil, a perched seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods. Permeability in this soil is slow. Available water capacity is moderate. Runoff is medium. The potential for frost action is high. The surface layer has a moderate organic matter content. Tilth is generally good.

The Glynwood soil is used for parks, open areas, lawns, and gardens. It is well suited to grasses, trees and shrubs, and flower and vegetable gardens. The erosion hazard and the seasonal wetness are the main limitations affecting these uses. The surface layer crusts after hard rains and clods if worked when wet. Erosion is especially a problem in disturbed areas where the

surface is bare. In radically altered areas, the soil is not well suited to lawns and gardens. Tilth is very poor if the subsoil or underlying material is exposed in these areas. The exposed material is sticky when wet and hard when dry.

The Glynwood soil is well suited to dwellings and recreational uses. The seasonal wetness and a moderate shrink-swell potential are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. Foundation walls should be reinforced and should be backfilled with material that has a low shrink-swell potential. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action. Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

Most areas are served by sewers. The Glynwood soil is only moderately well suited to septic tank absorption fields because of the seasonal wetness and the slow permeability. Perimeter drains around the absorption field help to lower the seasonal high water table. Enlarging the absorption field helps to overcome the restricted permeability.

No land capability classification or woodland ordination symbol is assigned.

KeB—Kendallville loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil generally is on stream terraces. In some areas it is on low knolls on ground moraines and end moraines. Most areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is dark brown, firm clay loam and gravelly clay loam, and the lower part is brown, mottled, firm gravelly clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, firm silt loam glacial till. In some areas the subsoil is thicker. In a few areas the surface layer is silt loam.

Included with this soil in mapping are small areas of Glynwood and Ockley soils. The moderately well drained Glynwood soils are in hummocky areas on uplands. Ockley soils are on low knolls. They are underlain by coarse textured glacial outwash. Also included are small areas of somewhat poorly drained soils in drainageways and depressions. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Kendallville soil. Available water capacity is moderate. Runoff is medium. Tilth is good. The surface layer has a moderate organic matter content.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, and small grain. It dries out early in the spring. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility.

This soil is moderately well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and moderately well suited to septic tank absorption fields. The moderately slow permeability and a moderate shrink-swell potential in the subsoil are the main limitations affecting these uses. The damage to buildings caused by shrinking and swelling can be minimized by strengthening foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading hasten reestablishment of the plant cover. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action.

Installing septic tank absorption fields in suitable fill material improves the ability of the fields to absorb effluent. The included Ockley soils are better suited to septic tank absorption fields.

The land capability classification is IIe. The woodland ordination symbol is 5A.

KeD2—Kendallville loam, 12 to 18 percent slopes, eroded. This deep, moderately steep, well drained soil is on side slopes on stream terraces. Small gullies have formed in some areas. Erosion has removed part of the original surface layer. Subsoil material with a higher content of clay has been mixed into the present surface layer. Most areas are irregularly shaped and range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is dark brown and dark yellowish brown, firm clay loam about 21 inches thick. The underlying material to a depth of about 60 inches is mottled, firm glacial till. It is dark yellowish brown clay loam in the upper part and yellowish brown loam in the lower part. In a few areas the lower part of the subsoil has thin strata of sand and gravelly loamy sand. In some areas the depth to the underlying glacial till is 41 to 60 inches.

Included with this soil in mapping are small areas of Glynwood and Ockley soils. The moderately well drained Glynwood soils are on the upper part of the slopes. Ockley soils are on the lower part. They are underlain by coarse textured glacial outwash. Also included, on the upper part of the slopes, are small areas of steep soils and severely eroded areas where tilth is poor. Included soils make up about 15 percent of most mapped areas.

Permeability is moderately slow in the Kendallville soil. Available water capacity is moderate. Runoff is very rapid. The surface layer has a moderately low organic matter content.

A few small areas are used as cropland. This soil is poorly suited to cultivated crops. Erosion is the main management concern. It has resulted in a less productive soil that is more difficult to manage. The short, moderately steep slopes hinder the use of machinery and the application of erosion-control measures. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Including close-growing crops in the cropping sequence also helps to control erosion. Grassed waterways help to prevent gullying.

A few areas are used as pasture. A cover of pasture plants or hay reduces the erosion hazard. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

Many areas are used as woodland. The slope and the erosion hazard are the main management concerns. Erosion along logging roads and skid trails can be controlled by water bars or a vegetative cover. Constructing the logging roads in the less sloping areas facilitates the use of equipment. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to dwellings and septic tank absorption fields. The slope, the moderately slow permeability, and a moderate shrink-swell potential in the subsoil are the main limitations affecting these uses. Extensive land shaping generally is necessary. The damage to buildings caused by shrinking and swelling can be minimized by strengthening foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Erosion is a hazard during construction. Stockpiling the surface layer and then spreading it during the final grading hasten reestablishment of the plant cover. Runoff channels should be protected against erosion by a cover of grasses or by stone riprap. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action. Building on the contour helps to overcome the slope.

Installing the distribution lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. Enlarging the absorption area improves the capacity of the field to absorb the effluent.

The land capability classification is IVe. The woodland ordination symbol is 5R.

La—Latty silty clay. This deep, nearly level, very poorly drained soil is on broad flats on lake plains. It receives runoff from the higher adjacent soils and is subject to ponding (fig. 6). Slope is 0 to 2 percent. Most areas are broad and irregularly shaped and range from 200 to several thousand acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay about 7 inches thick. The subsoil is dark gray and gray, mottled, firm and very firm silty clay about 42 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, firm silty clay. In some areas both the subsoil and the underlying material have less clay. In a few areas the subsoil has more clay. In a few places the surface layer is very dark gray.

Included with this soil in mapping are small areas of Fulton and Milford soils. The somewhat poorly drained Fulton soils are on slight rises. Milford soils have a surface layer that is darker than that of the Latty soil and have less clay in the subsoil. They are along drainageways, in depressions, and along the periphery of the mapped areas. Also included are a few areas of soils that are subject to rare flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is very slow in the Latty soil. Available water capacity is moderate. Runoff is very slow or ponded. A perched seasonal high water table is near or above the surface during extended wet periods. Tilth is poor. The surface layer has a moderate organic matter content and crusts after hard rains. The shrink-swell potential is high. Cracks commonly form when the soil is very dry. Water infiltration is rapid after the cracks have formed. If the soil is saturated, however, infiltration is very slow.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness and the high content of clay throughout the soil are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting. Subsurface drains should be closely spaced because water moves very slowly into these drains. Deepening outlet ditches improves the effectiveness of the subsurface drainage system. In some areas outlets are ineffective when the nearby rivers and streams flood. A good drainage system is needed if a no-till system of planting is used.

Fall tillage that leaves a rough or ridged surface and partly covers the crop residue allows this soil to dry more quickly in the spring. A heavy cover of crop residue or mulch slows warming and drying of the soil in the spring. Returning crop residue to the soil and adding other

Figure 6.—Ponding on Latty silty clay.

organic material minimize surface crusting and improve tilth and fertility. Compaction is a serious problem if the soil is tilled or crops are planted or harvested during wet periods. Including deep-rooted meadow crops in the cropping sequence improves soil structure and internal drainage.

The pasture species selected for planting should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet improve the pasture.

A few areas are used as woodland. The wetness and the high content of clay throughout the soil are limitations. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can be logged during the drier parts of the year or when the soil is frozen.

Some areas are used as wildlife habitat. Because of the shallow water and very wet soil conditions, this soil is well suited to wetland wildlife habitat. It is well suited to ponds and shallow reservoirs because of the high water table and the very slow permeability.

This soil is generally unsuitable as a site for buildings and septic tank absorption fields. The ponding, the very slow permeability, and the high shrink-swell potential are the major limitations affecting these uses.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

MaA—Martinsville loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil generally is on stream terraces and along the shoreline of former glacial lakes. In a few areas it is on uplands. Most areas are long and narrow or irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is brown, friable loam about 10 inches thick. The subsoil extends to a depth of about 70 inches. It is dark yellowish brown, firm loam in the upper part; yellowish brown, friable sandy loam in the next part; and dark yellowish brown, mottled, very friable sandy loam in the lower part. In some areas the subsoil has layers in which the content of gravel is more than 15 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Fitchville and Whitaker soils. These soils are along drainageways, in depressions, and along the periphery of the mapped areas. Also included are areas of soils that are subject to rare flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the Martinsville soil. Available water capacity is high. Runoff is slow. Tilth is good. The surface layer has a moderate organic matter content.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. It dries out early in the spring. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Returning crop residue to the soil and adding other organic material conserve moisture and improve tilth and fertility. The soil is well suited to irrigation.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential in the subsoil is a limitation on sites for buildings without basements. Extending the foundations of these buildings to the underlying material minimizes the structural damage caused by shrinking and swelling. Properly landscaping building sites helps to divert surface water away from foundations. The included soils that are subject to rare flooding should not be selected as sites for buildings. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action. Sloughing is a hazard in shallow excavations.

The land capability classification is I. The woodland ordination symbol is 4A.

MaB—Martinsville loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on stream terraces and on knolls and ridges along the shoreline of former glacial lakes. Most areas are long and narrow or irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable loam about 10 inches thick. The subsoil extends to a depth of about 70 inches. The upper part is yellowish brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is dark yellowish brown, friable, stratified loam and sandy loam. In a few places the soil has more silt and less sand throughout. In some areas the subsoil has layers in which the content of gravel is more than 15 percent. In a few areas the soil is moderately well drained.

Included with this soil in mapping are small areas of the somewhat poorly drained Whitaker soils. These soils are along drainageways, in depressions, and along the periphery of the mapped areas. They make up about 10 percent of most mapped areas.

Permeability is moderate in the Martinsville soil. Available water capacity is high. Runoff is medium. Tilth is good. The surface layer has a moderate organic matter content.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, and small grain. It dries out early in the spring. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. The soil is well suited to irrigation.

This soil is moderately well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential in the subsoil is a limitation on sites for buildings without basements. Extending the foundations of these buildings to the underlying material minimizes the structural damage caused by shrinking and swelling. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by frost action and by

shrinking and swelling. Sloughing is a hazard in shallow excavations.

The land capability classification is IIe. The woodland ordination symbol is 4A.

Me—Medway clay loam, rarely flooded. This deep, nearly level, moderately well drained soil is on low stream terraces. It is subject to rare flooding during winter and during spring and other periods of excessive rainfall. Slope is 0 to 2 percent. Most areas are long and narrow or irregularly shaped and range from 10 to 400 acres in size.

Typically, the surface layer is black, firm clay loam about 11 inches thick. The subsurface layer also is black, firm clay loam. It is about 4 inches thick. The subsoil is about 35 inches thick. The upper part is dark yellowish brown and olive brown, mottled, firm and very firm clay loam, and the lower part is yellowish brown, mottled, firm loam. The underlying material to a depth of about 60 inches is dark yellowish brown, mottled, friable sandy loam. In some areas the subsoil has more silt.

Included with this soil in mapping are small areas of Milford, Ockley, and Sloan soils. The very poorly drained Milford and Sloan soils are in depressions and along drainageways. The well drained Ockley soils are on slight rises. Included soils make up about 20 percent of most mapped areas.

Permeability is moderate in the Medway soil. Available water capacity is high. Runoff is slow. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high. A seasonal high water table is at a depth of 1.5 to 3.0 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. The rare flooding and the wetness delay planting in some years. The hazard of flooding can be reduced by clearing logjams and other obstructions in stream channels. Subsurface drains are needed in areas of the wetter included soils. No-till planting or another system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and minimizes crusting.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

Mainly because of the seasonal wetness and the rare flooding, this soil is generally unsuitable as a site for buildings and is poorly suited to septic tank absorption fields and recreational uses. Recreational facilities and such structures as roads, bridges, and farm buildings should be specially designed so that they are less likely to be damaged by floodwater. Fill material can elevate the structures above the known high flooding level. Perimeter drains help to lower the seasonal high water table on sites for septic tank absorption fields. Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is I. The woodland ordination symbol is 5A.

Mf—Milford silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats, in shallow depressions, and along drainageways on lake plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are broad and irregularly shaped and range from 50 to several hundred acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 13 inches thick. The subsoil is dark gray and gray, mottled, firm silty clay loam about 34 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, firm silty clay loam. It is lacustrine material. In some areas the subsoil contains less clay. In a few areas the surface layer is dark gray. In places the underlying material is glacial till.

Included with this soil in mapping are small areas of Del Rey and Latty soils and small areas of organic soils. Del Rey soils are somewhat poorly drained and are on slight rises. Latty soils and the organic soils are very poorly drained and are in depressions. Also included are a few areas of soils that are subject to rare flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Milford soil. Available water capacity is high. Runoff is very slow or ponded. A seasonal high water table is near or above the surface during extended wet periods. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. Seasonal wetness and soil compaction are the main management concerns. A combination of surface and subsurface drains is used to remove excess surface water and lower the seasonal high water table. In some areas drainage outlets are ineffective when the nearby open ditches and streams flood. Deepening the outlet ditches improves the effectiveness of the subsurface drainage system. A good drainage system is needed if a no-till system of planting is used. Limiting fieldwork when the soil is wet minimizes compaction. In some areas grassed waterways can help to control surface water.

The pasture species selected for planting should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet improve the pasture.

This soil is poorly suited to dwellings, septic tank absorption fields, and recreational uses. The ponding and the moderately slow permeability are the main

limitations affecting these uses. The included soils that are subject to rare flooding should not be selected as sites for buildings. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength, ponding, and frost action.

Suitable fill material can raise septic tank absorption fields above normal ponding levels. Also, it improves the capacity of the field to absorb effluent.

Recreational areas can be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is IIw. No woodland ordination symbol is assigned.

MnB—Milton silt loam, 1 to 4 percent slopes. This moderately deep, gently sloping, well drained soil is on ground moraines and end moraines. Most areas are irregularly shaped and range from 40 to 150 acres in size.

Typically, the surface layer is brown, friable silt loam about 12 inches thick. The subsoil is about 17 inches thick. The upper part is dark yellowish brown, firm silty clay loam, and the lower part is brown and dark brown, firm and very firm clay. Hard, unweathered limestone bedrock is at a depth of about 29 inches. In some areas the subsoil has less clay. In other areas the depth to bedrock is 40 to 60 inches.

Included with this soil in mapping are small areas of the moderately well drained Glynwood soils. These soils are in positions on the landscape similar to those of the Milton soil. Also included, around the periphery of the mapped areas, are narrow strips where the soil has a very dark gray surface layer and is somewhat poorly drained. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate or moderately slow in the Milton soil. Available water capacity is low. Runoff is medium. Tilth is generally good. The surface layer has moderate organic matter content and crusts after hard rains. The root zone is moderately deep.

This soil is used mainly as cropland. It is moderately well suited to corn, soybeans, small grain, hay, and pasture. Because of droughtiness, it is better suited to crops that mature early in the growing season than to other crops. It dries earlier in the spring than most of the other soils in the county, and plants often show evidence of moisture stress in late summer. Erosion is a hazard. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility.

The pasture species selected for seeding should be those that are tolerant of the droughtiness. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to dwellings and is poorly suited to septic tank absorption fields. The bedrock at a depth of 20 to 40 inches, a moderate shrink-swell potential, and the moderate or moderately slow permeability limit these uses. Because of the depth to bedrock, the soil is better suited to buildings without basements than to buildings with basements. Blasting of the bedrock is generally needed before a basement can be constructed. The amount of blasting needed depends on the extent to which the bedrock is fractured. Foundation walls and concrete slabs should be reinforced and should be backfilled with material that has a low shrink-swell potential. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by low strength.

The effluent from sanitary facilities can move through fissures in the limestone bedrock and pollute underground water supplies. Suitable fill material can elevate septic tank absorption fields above the bedrock. Also, it can improve the ability of the field to absorb the effluent. Central sewage systems should be used if possible.

The land capability classification is IIe. The woodland ordination symbol is 4A.

Mu—Muskego muck. This deep, nearly level, very poorly drained soil is in depressions on till plains and lake plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are oblong or roughly circular and are 5 to 10 acres in size.

Typically, the surface layer is black, very friable muck about 16 inches thick. The next 8 inches is dark reddish brown, firm, nonsticky muck. The underlying material to a depth of about 60 inches is very dark gray and dark grayish brown, nonsticky and slightly plastic sedimentary peat. It has many small white snail shells in the lower part. In some areas the muck is more than 51 inches deep over sedimentary peat.

Included with this soil in mapping are a few narrow strips of the silty Milford soils. These soils are around the periphery of the mapped areas. They make up about 5 percent of most mapped areas.

Permeability is moderate or moderately rapid in the mucky part of the Muskego soil and slow in the sedimentary peat. Available water capacity is very high. The surface layer has a very high organic matter content. Runoff is very slow or ponded. A seasonal high water table is near or above the surface during extended wet periods. The potential for frost action is high.

This soil supports wetland vegetation, mainly cattails, sedges, and reeds. It is generally unsuited to cultivated crops, small grain, hay, and pasture. It is moderately well suited to cultivated crops in a few areas where a drainage system has been installed. The very poor natural drainage, the ponding, and poor trafficability are the major limitations. A subsurface drainage system is effective in removing excess water, but suitable outlets are not readily available in many areas. Ditchbanks are unstable. Drained areas are subject to subsidence, which can displace the subsurface drains.

This soil is soft and highly compressible and commonly cannot support narrow-wheeled farm equipment, especially when it is wet. It readily absorbs water, nutrients, and herbicides because of the very high content of organic matter. Soil blowing is a major hazard in cultivated areas. It can be controlled by planting cover crops, establishing windbreaks, returning crop residue to the soil, and irrigating. Fire is a hazard during extended dry periods.

This soil is well suited to habitat for wetland wildlife. The wetness severely limits seedling establishment.

This soil is generally unsuited to dwellings and septic tank absorption fields because of the ponding, subsidence, and the slow permeability. A drainage system is needed on sites for local roads and streets. Replacing the muck and sedimentary peat with suitable base material improves the roads and streets.

The land capability classification is VIw. No woodland ordination symbol is assigned.

Ne—Newark silt loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. It is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 12 inches thick. The subsoil is brown, grayish brown, and dark grayish brown, mottled, friable silt loam about 32 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, friable silt loam. In some areas the subsoil has more clay. In a few areas the soil is moderately well drained.

Included with this soil in mapping are small areas of Nolin and Sloan soils. The well drained Nolin soils are commonly in the slightly higher landscape positions. The very poorly drained Sloan soils are in depressions and old meander channels. Also included are areas of soils that are frequently flooded. Included soils make up less than 15 percent of most mapped areas.

Permeability is moderate in the Newark soil. Available water capacity is high. Runoff is very slow. Tilth is good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A seasonal high water table is at a depth of 0.5 foot to 1.5 feet during extended wet periods.

Some areas are used as cropland. A few are pastured or are idle. Drained areas of this soil are well suited to corn, soybeans, hay, and pasture, but undrained areas are poorly suited. Winter grain crops generally are not grown because of the flooding hazard. The flooding and the seasonal wetness are the main management concerns. A combination of surface and subsurface drains lowers the seasonal high water table. In most areas adequate drainage outlets are not readily available and are submerged when the nearby streams and rivers flood. Levees reduce the flooding hazard. A good drainage system is needed if a no-till system of planting is used. Limiting fieldwork when the soil is wet minimizes soil compaction. Winter cover crops protect the soil against scouring during periods of flooding.

The pasture species selected for seeding should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

Many areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

Because of the flooding and the seasonal wetness, this soil is generally unsuitable as a site for buildings and septic tank absorption fields.

The land capability classification is IIw. The woodland ordination symbol is 4A.

No—Nolin silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. It is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 8 inches thick. The subsoil is brown and dark yellowish brown, friable and firm silt loam about 32 inches thick. It is mottled below a depth of about 33 inches. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm, stratified silt loam and silty clay loam. In a few areas the subsoil has more sand and less silt. In some areas the soil is moderately well drained. In places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils and very poorly drained Sloan soils. These soils commonly are in the lower areas. Also included are areas of soils that are

frequently flooded. Included soils make up less than 15 percent of most mapped areas.

Permeability is moderate in the Nolin soil. Available water capacity is high. Runoff is slow. Tilth is generally good unless the soil is plowed when wet. The surface layer has a moderate organic matter content and crusts after hard rains. A seasonal high water table is at a depth of 3 to 6 feet during extended wet periods.

Most areas are used as cropland. A few are used as pasture or are left idle. This soil is well suited to corn and soybeans. Winter grain crops are usually not grown because of the occasional flooding. Levees reduce the hazard of flooding. Winter cover crops protect the soil against scouring during periods of flooding. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Returning crop residue to the soil and adding other organic material minimize crusting and improve tilth and fertility.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

Because of the flooding, this soil is generally unsuited to dwellings and septic tank absorption fields.

The land capability classification is IIw. The woodland ordination symbol is 5A.

OcA—Ockley loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on stream terraces. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown, friable loam; the next part is dark brown, firm clay loam and gravelly clay loam; and the lower part is yellowish brown, friable very gravelly sandy loam. The underlying material to a depth of about 75 inches is yellowish brown, loose very gravelly loamy sand.

Included with this soil in mapping are small areas of Fox and Sleeth soils. Fox soils have a subsoil that is thinner than that of the Ockley soil. They are on slight rises. The somewhat poorly drained Sleeth soils are in depressions and along drainageways. Also included are areas of soils that are subject to rare flooding. Included soils make up less than 10 percent of most mapped areas.

Permeability is moderate in the subsoil of the Ockley soil and very rapid in the underlying material. Available water capacity is moderate. Runoff is slow. Tilth is good. The surface layer has a moderate organic matter content.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. It dries out early in the spring. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Returning crop residue to the soil and adding other organic material conserve moisture and improve tilth and fertility. The soil is well suited to irrigation.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings. The structural damage caused by shrinking and swelling can be minimized by reinforcing foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Properly landscaping building sites helps to divert surface water away from foundations. The included soils that are subject to rare flooding should not be selected as sites for buildings. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by low strength and by shrinking and swelling. Sloughing is a hazard in shallow excavations.

The land capability classification is I. The woodland ordination symbol is 5A.

OcB—Ockley loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil generally is on stream terraces. In a few areas it is on the hummocky parts of moraines. Small cobblestones are on the surface in some areas. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is brown, friable loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown, firm clay loam and gravelly clay loam; the next part is dark brown, friable gravelly sandy clay loam; and the lower part is yellowish brown, friable gravelly loam. The underlying material to a depth of about 70 inches is yellowish brown, loose very gravelly loamy sand.

Included with this soil in mapping are small areas of Fox and Kendallville soils. Fox soils have a subsoil that is thinner than that of the Ockley soil. They are on slight rises and in the more sloping areas. Kendallville soils are underlain by glacial till. They are on low knolls and side slopes. Included soils make up about 5 percent of most mapped areas.

Permeability is moderate in the subsoil of the Ockley soil and very rapid in the underlying material. Available water capacity is moderate. Runoff is medium. Tilth is good. The surface layer has a moderate organic matter content.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. It dries out early in the spring. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. The soil is well suited to irrigation.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings. The structural damage caused by shrinking and swelling can be minimized by reinforcing foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by low strength and by shrinking and swelling. Sloughing is a hazard in shallow excavations.

The land capability classification is IIe. The woodland ordination symbol is 5A.

Pa—Paulding clay. This deep, nearly level, very poorly drained soil is on broad flats on lake plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Areas are broad and irregularly shaped and range from 200 to more than 2,000 acres in size.

Typically, the surface layer is dark gray, firm clay about 8 inches thick. The subsoil is dark gray and gray, mottled, very firm clay about 45 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, very firm clay. It is lacustrine material. In places the soil has a surface layer of silty clay and has less clay in the subsoil. In a few areas the surface layer is very dark gray and has slightly more organic matter. In some small areas the underlying material is glacial till.

Included with this soil in mapping are small areas of Fulton and Milford soils. The somewhat poorly drained Fulton soils are on slight rises. Milford soils have a surface layer that is darker than that of the Paulding soil. They are along drainageways, in depressions, and along the periphery of the mapped areas. Included soils make up about 10 percent of most mapped areas.

Permeability is very slow in the Paulding soil. Available water capacity is moderate. Runoff is very slow or ponded. A perched seasonal high water table is near or above the surface during extended wet periods. Tilth is poor. The surface layer has a moderate organic matter content and crusts after hard rains. The shrink-swell potential is high. Cracks commonly form when the soil is very dry. Water infiltration is rapid after the cracks have formed. If the soil is saturated, however, infiltration is very slow.

This soil is used mainly as cropland. It is poorly suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness and the high content of clay throughout the soil are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting. Subsurface drains should be closely spaced because water moves very slowly into these drains. Deepening outlet ditches improves the effectiveness of the subsurface drainage system. In some areas outlets are ineffective when the nearby rivers and streams flood.

Fall tillage that leaves a rough or ridged surface and partly covers the crop residue allows the soil to dry out more quickly in the spring. A substantial cover of crop residue or mulch slows warming and drying of the soil in the spring. The soil is better suited to ridge tillage than to no-till planting. A good drainage system is needed if a no-till system is used. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Compaction is a serious problem if the soil is tilled or crops are planted or harvested during wet periods. Including deep-rooted meadow crops in the cropping sequence improves soil structure and internal drainage.

The pasture species selected for planting should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet improve the pasture.

A few areas are used as woodland. The wetness and the high content of clay throughout the soil are limitations. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can

be logged during the drier parts of the year or when the soil is frozen.

Some areas are used as wildlife habitat. Because of the shallow water and very wet soil conditions, this soil is well suited to wetland wildlife habitat. It is well suited to ponds and shallow reservoirs because of the high water table and the very slow permeability.

This soil is generally unsuited to dwellings and septic tank absorption fields because of the ponding, the very slow permeability, and the high shrink-swell potential.

The land capability classification is IIIw. The woodland ordination symbol is 4w.

Pm—Pewamo silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats, in depressions, and along drainageways on ground moraines and end moraines. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are broad and irregularly shaped and range from 20 to more than several hundred acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 11 inches thick. The subsoil is about 42 inches thick. It is mottled and firm. The upper part is gray and grayish brown silty clay and silty clay loam, and the lower part is dark yellowish brown silty clay loam. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil has less clay. In other areas it is thicker. In places the surface layer is dark gray.

Included with this soil in mapping are small areas of the somewhat poorly drained Bennington and Blount soils on slight rises and areas of organic soils in a few small depressions. Also included, along drainageways, are some small areas of soils that are underlain by several feet of fine sand. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Pewamo soil. Available water capacity is high. Runoff is very slow or ponded. A seasonal high water table is near or above the surface during extended wet periods. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. Seasonal wetness and soil compaction are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table. In some areas drainage outlets are ineffective when the nearby open ditches and streams flood. Deepening the outlet ditches improves the effectiveness of the subsurface drainage system. Limiting fieldwork when the soil is wet minimizes compaction. Drained areas are well suited to no-till farming (fig. 7). In some areas grassed waterways can help to control surface water.

The pasture species selected for planting should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet improve the pasture.

A few areas are used as woodland. The wetness is a limitation. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is poorly suited to dwellings, septic tank absorption fields, and recreational uses. The ponding and the moderately slow permeability are the main limitations affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength, ponding, and frost action.

Suitable fill material can raise septic tank absorption fields above normal ponding levels. Also, it improves the capacity of the field to absorb effluent.

Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

The land capability classification is IIw. The woodland ordination symbol is 5W.

Po—Pewamo-Urban land complex. This map unit consists of a deep, nearly level, very poorly drained Pewamo soil and areas of Urban land. The unit is in broad areas on ground moraines and end moraines. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 10 to several hundred acres in size. They are about 50 percent Pewamo silty clay loam and about 35 percent Urban land. The Pewamo soil and the Urban land occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Pewamo soil has a surface layer of very dark gray, firm silty clay loam about 11 inches thick. The subsoil is about 42 inches thick. It is mottled and firm. The upper part is gray and grayish brown silty clay and silty clay loam, and the lower part is dark yellowish brown silty clay loam. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil has

Figure 7.—No-till corn in a drained area of Pewamo silty clay loam.

less clay. In other areas it is thicker. In some places the surface layer is dark gray. In other places the soil has been radically altered. Some of the low areas have been filled or leveled during construction, and other small areas have been cut, built up, or smoothed.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible. Moderately alkaline clay loam or silty clay loam glacial till commonly underlies the Urban land.

Included in this unit in mapping are small areas of the somewhat poorly drained Blount soils on slight rises. These soils make up about 15 percent of most mapped areas.

Most areas of this map unit are drained by sewer systems, gutters, and subsurface drains. In undrained areas of the Pewamo soil, a seasonal high water table is near or above the surface during extended wet periods. Runoff is very slow or ponded on this soil. Permeability is moderately slow. Available water capacity is high. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high.

The Pewamo soil is used for parks, open areas, lawns, and gardens. It is well suited to grasses, trees and shrubs, and flower and vegetable gardens. The ponding is the main hazard affecting these uses. The surface layer clods if worked when wet. Surface and subsurface drains remove excess water. The perennials selected for planting should be those that are tolerant of wetness.

Erosion is a problem in disturbed areas where the surface is unprotected for a considerable period. In radically altered areas, the soil is not so well suited to lawns and gardens. Tilth is very poor if the subsoil or underlying material is exposed in these areas. The exposed material is sticky when wet and hard when dry.

The Pewamo soil is poorly suited to dwellings and recreational uses. The ponding is the main hazard. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength, ponding, and frost action. Recreational areas should be landscaped so that excess water is removed. Also, a drainage system is needed.

Most areas are served by sewers. The Pewamo soil is poorly suited to septic tank absorption fields because of the ponding and the moderately slow permeability. Suitable fill material can raise the absorption field above normal ponding levels. Also, it can improve the capacity of the field to absorb effluent.

No land capability classification or woodland ordination symbol is assigned.

Ps—Pits, gravel. These are areas from which gravel and sand have been excavated. These excavations are typically in hummocky areas and on stream terraces. They are adjacent to areas of Fitchville, Fox, and Martinsville soils. Slopes are very irregular because of spoil piles, overburden, and unmined banks. Clay loam glacial till is at the base of some of the pits.

The pits vary considerably in size and depth. Most are 5 to 50 acres in size. Pits smaller than 1 acre are identified by a spot symbol on the soil maps. Many of the smaller pits have not been recently mined. Most areas support little or no vegetation but are being slowly revegetated by a natural plant succession of weeds and grasses, shrubs, and drought-tolerant trees.

The stripped soil material making up the spoil banks varies in thickness and composition within short distances. It has poor physical properties. It is commonly gravelly and sandy and is droughty. It is poorly suited to plants. It is subject to erosion and is a potential source of siltation.

Most abandoned gravel pits are used as habitat for wildlife or as pasture. Some support stands of second-growth timber. This unit is best suited to wildlife habitat and to some recreational uses. It is generally unsuitable as cropland because of the irregular slopes, a shallow root zone, and low fertility. It is generally unsuited to sanitary landfills because the pollution of underground water supplies is a hazard. Onsite investigation is needed to determine the suitability for buildings and sanitary facilities.

Establishing a plant cover on abandoned sites reduces the hazards of erosion and siltation. The grasses and trees that can withstand droughtiness and the somewhat unfavorable soil properties should be selected for planting.

No land capability classification or woodland ordination symbol is assigned.

Pt—Pits, quarry. These are areas where dolomitic limestone or shale has been quarried. The quarries are commonly on uplands and are adjacent mainly to areas of Milton and Glynwood soils. Shale has been quarried from one pit in Tully Township. Most of the quarries have a high wall on one or more sides. They are irregularly shaped and range from 5 to 300 acres in size. Actively mined quarries are continually being enlarged.

Included in this unit in mapping are small stockpiles of overburden, areas of loose and processed stone, and processing plants.

The overburden is usually stockpiled or is used as earthfill. The material below the original soil is generally calcareous. It is very low in content of organic matter. It is highly susceptible to erosion. Available water capacity varies.

Establishing a plant cover in areas that are no longer mined reduces the risks of erosion and siltation. The plant cover is more easily established and maintained if these areas are blanketed with topsoil. The species that can withstand a fairly low available water capacity and the unfavorable soil properties should be selected for planting.

Some quarries contain water and can be developed for use as wildlife habitat or recreational areas. The quarries are generally unsuited to sanitary landfills because the pollution of underground water supplies is a hazard.

No land capability classification or woodland ordination symbol is assigned.

Sa—Saranac silty clay loam, occasionally flooded. This deep, nearly level, very poorly drained soil is on broad flood plains. It is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 50 to 100 acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 12 inches thick. The subsurface layer is black, firm silty clay loam about 5 inches thick. The subsoil is about 18 inches of dark gray, mottled, very firm silty clay and firm silty clay loam. The underlying material to a depth of about 60 inches is gray, mottled, firm, stratified silty clay loam and silty clay. In some areas the subsoil has less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Del Rey, Fitchville, and

Whitaker soils. These soils are on slight rises. Also included are small areas of organic soils in depressions and oxbows. These areas often remain ponded for a month or more after floodwaters have receded. Included soils make up less than 15 percent of most mapped areas.

Permeability is moderately slow in the Saranac soil. Available water capacity is high. Runoff is very slow. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high. A seasonal high water table is near the surface during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, hay, and pasture. Winter grain crops are usually not grown because of the occasional flooding. The flooding and the seasonal wetness are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table. In most areas adequate drainage outlets are not readily available and are submerged when the nearby streams and rivers flood. Levees reduce the hazard of flooding. Winter cover crops protect the soil against scouring during periods of flooding. A good drainage system is needed in areas where a no-till system of planting is applied. Limiting fieldwork when the soil is wet minimizes soil compaction.

The pasture species selected for planting should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet improve the pasture.

A few areas are used as woodland. The wetness and the flooding are management concerns. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is generally unsuited to dwellings and septic tank absorption fields and is poorly suited to most recreational uses. The occasional flooding, the seasonal wetness, and the moderately slow permeability are the major limitations affecting these uses.

The land capability classification is IIIw. The woodland ordination symbol is 5W.

Sc—Saranac silty clay loam, frequently flooded. This deep, nearly level, very poorly drained soil is on broad flood plains. It is frequently flooded during winter and spring. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 50 to 100 acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 12 inches thick. The subsoil is about 23 inches of gray, mottled, firm silty clay and silty clay loam. The underlying material to a depth of about 60 inches is gray, mottled, firm, stratified silty clay loam and silty clay. In some areas the subsoil has less clay.

Included with this soil in mapping are small areas of organic soils in depressions and oxbows. These soils remain ponded for several months after floodwaters have receded. They make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Saranac soil. Available water capacity is high. Runoff is very slow. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high. A seasonal high water table is near the surface during extended wet periods.

Some areas of this soil are used for late-season crops, mainly short-season varieties of soybeans. A few areas are left idle. Undrained areas that are not protected from flooding are generally unsuited to corn, small grain, hay, and pasture. Drained areas are poorly suited. The frequent flooding and the seasonal wetness are the main management concerns. They delay planting and severely limit the choice of crops. Planting should be delayed until flooding is no longer a major hazard. Replanting is often necessary following periods of flooding in late spring or early summer. Surface drains help to remove floodwater from the lower areas. In most areas adequate outlets for subsurface drainage systems are not available. Levees reduce the hazard of flooding. Winter cover crops protect the soil against scouring during periods of flooding. Limiting fieldwork when the soil is wet minimizes soil compaction.

A few areas are used as woodland. The wetness and the flooding are management concerns. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is generally unsuited to dwellings, septic tank absorption fields, and most recreational uses. The frequent flooding, the moderately slow permeability, and the seasonal wetness are the major limitations affecting these uses.

The land capability classification is IVw. The woodland ordination symbol is 5W.

ShB—Shinrock silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is

in hummocky or dissected areas on lake plains. Most areas are irregularly shaped and range from 5 to 200 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 28 inches thick. It is mottled and firm. The upper part is yellowish brown silty clay loam and silty clay, and the lower part is olive brown silty clay. The underlying material to a depth of about 60 inches is light olive brown, firm silty clay loam. In some areas the subsoil contains less clay. In a few areas the soil is well drained. In some small areas the surface layer is eroded.

Included with this soil in mapping are small areas of Del Rey and Milford soils. The somewhat poorly drained Del Rey soils are on flats. The very poorly drained Milford soils are in depressions and along drainageways. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Shinrock soil. Available water capacity is moderate. Runoff is medium. Tilth is generally good. The surface layer has a moderate organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, and small grain. Erosion is the main management concern. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction. Random subsurface drains commonly are installed in the wetter included soils.

This soil is well suited to hay and pasture. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. It is caused by the high content of clay in the subsoil. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to dwellings and moderately well suited to septic tank absorption fields. The seasonal wetness, the moderately slow permeability, and a moderate shrink-swell potential are the main limitations affecting these uses. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The backfill material around foundations should be porous enough for good drainage. The structural damage caused by shrinking and swelling can be minimized by reinforcing foundation walls and concrete slabs and by backfilling with material that has a low shrink-swell potential. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action. The sides of shallow excavations can cave in unless they are reinforced.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIe. The woodland ordination symbol is 4C.

ShC2—Shinrock silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on side slopes and in dissected areas on lake plains. Erosion has removed part of the original surface layer. Subsoil material with a higher content of clay has been mixed into the present surface layer. Most areas are long and narrow and range from 5 to 25 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is yellowish brown and olive brown, mottled, firm silty clay loam about 22 inches thick. The underlying material to a depth of about 60 inches is olive brown, mottled, friable, stratified silt loam and silty clay loam. In a few areas the subsoil has less clay. In some areas the soil is well drained. In places it has a surface layer of silty clay loam and is shallower to the underlying material.

Included with this soil in mapping are small seeps and a few severely eroded areas on side slopes. Tilth is poor in the severely eroded areas. Included soils make up about 10 percent of most mapped areas.

Permeability is moderately slow in the Shinrock soil. Available water capacity is moderate. Runoff is rapid. Tilth is generally good. The surface layer has a moderately low organic matter content and crusts after hard rains. The potential for frost action is high. A perched seasonal high water table is at a depth of 2.0 to 3.5 feet during extended wet periods.

Most areas are used as cropland. Some are used as permanent pasture. This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. It has resulted in a less productive soil that is more difficult to manage. No-till planting or another system of conservation tillage that

leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping sequence also helps to control erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels can minimize soil compaction.

A cover of pasture plants or hay reduces the hazard of erosion. Rotation grazing, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep the pasture in good condition.

A few areas are used as woodland. Seedling mortality is the main management concern. It is caused by the high content of clay in the subsoil. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs.

This soil is only moderately well suited to dwellings because of the seasonal wetness, the slope, and a moderate shrink-swell potential. The natural drainageways and the included seepy areas should not be selected as building sites. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during the final grading hasten reestablishment of the plant cover.

Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. Foundation walls should be reinforced and should be backfilled with material that has a low shrink-swell potential. The backfill material should be porous enough for good drainage. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action. The sides of shallow excavations can cave in unless they are reinforced.

This soil is poorly suited to septic tank absorption fields because of the wetness and the moderately slow permeability. Enlarging the absorption area helps to overcome the restricted permeability. Perimeter drains around the absorption field help to lower the seasonal high water table. Installing the distribution lines on the contour minimizes the seepage of effluent to the surface.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

SkA—Sleeth loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on stream terraces. Most areas are irregularly shaped and range from 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 11 inches thick. The subsoil is about 49 inches thick. The upper part is brown and yellowish brown, mottled, firm clay loam; the next part is grayish brown, mottled, firm sandy clay loam; and the lower part is dark gray, mottled, very friable gravelly sandy loam. The underlying material to a depth of about 80 inches is dark gray, loose, stratified sand and very gravelly sand. In some areas the surface layer is silt loam. In other areas it is very dark grayish brown. In a few areas the underlying material is glacial till.

Included with this soil in mapping are small areas of Bennington, Blount, and Westland soils. Bennington and Blount soils have more clay in the subsoil than the Sleeth soil and are underlain by glacial till. They are on the periphery of the mapped areas. The very poorly drained Westland soils are along drainageways and in depressions. Also included are areas of soils that are subject to rare flooding and slightly elevated areas of moderately well drained soils. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the subsoil of the Sleeth soil and very rapid in the underlying material. Available water capacity is high. Runoff is slow. Tilth is good. The surface layer has a moderate organic matter content. The potential for frost action is high. A seasonal high water table is at a depth of 1 to 3 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness is the main management concern. A subsurface drainage system helps to lower the seasonal high water table. In some areas outlets for subsurface drains are submerged when the nearby rivers and streams flood. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in areas where a no-till system is applied. Returning crop residue to the soil and adding other organic material improve tilth and fertility.

The pasture species selected for seeding should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to dwellings and poorly suited to septic tank absorption fields. The wetness is the main limitation affecting these uses. The included soils that are subject to rare flooding should not be selected as sites for buildings. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep

basements dry. In some areas drainage outlets are submerged when the nearby rivers and streams flood. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength and frost action. Sloughing is a hazard in shallow excavations.

Enlarging the absorption area in septic tank absorption fields helps to overcome the restricted permeability of this soil. Perimeter drains around the absorption field help to lower the seasonal high water table.

The land capability classification is IIw. The woodland ordination symbol is 5A.

So—Sloan silty clay loam, occasionally flooded. This deep, nearly level, very poorly drained soil is in depressions and old meander channels on flood plains. It is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas are long and narrow or irregularly shaped and range from 20 to 200 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 3 inches thick. The subsoil is about 36 inches of dark gray and gray, mottled, friable silt loam and firm clay loam. The underlying material to a depth of about 60 inches is strong brown, mottled, firm silty clay loam. In some areas the subsoil has more silt. In a few areas it has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils on slight rises. Also included are small areas of organic soils in oxbows and depressions. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate or moderately slow in the Sloan soil. Available water capacity is high. Runoff is very slow. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high. A seasonal high water table is near the surface during extended wet periods.

Most areas are used as cropland. A few are left idle. This soil is well suited to corn, soybeans, hay, and pasture. Winter grain crops are usually not grown because of the occasional flooding. The flooding and the seasonal wetness are the main management concerns. A combination of surface and subsurface drains lowers the seasonal high water table. In most areas adequate drainage outlets are not readily available and are commonly submerged when the nearby streams and rivers flood. Levees reduce the hazard of flooding. Winter cover crops protect the soil against scouring during periods of flooding. A good drainage system is needed in areas where a no-till system of planting is applied. Limiting fieldwork when the soil is wet minimizes soil compaction.

The pasture species selected for seeding should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. The wetness and the flooding are management concerns. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is generally unsuited to dwellings and septic tank absorption fields and is poorly suited to most recreational uses. The occasional flooding, the seasonal wetness, and the moderate or moderately slow permeability limit these uses.

The land capability classification is IIIw. The woodland ordination symbol is 5W.

Ud—Udorthents, loamy. These deep, gently sloping soils are in cut and filled areas and in landfills that have been blanketed with soil material. Earth moving and grading have removed or mixed the original surface layer, subsoil, and underlying material. Slope ranges from 1 to 4 percent. Most areas are 10 to 200 acres in size.

Typically, the upper 24 inches is silty clay loam and clay loam. The underlying material is dark gray, firm and very firm clay loam.

Included with these soils in mapping are small areas where fill is shallow over undisturbed soils. Also included are small areas of wood, metal, glass, rubber, and other debris. Inclusions make up about 20 percent of most areas.

Runoff is medium on the Udorthents. The content of organic matter is very low. Permeability generally is very slow, but it varies. Available water capacity is very low. The soils are commonly neutral to moderately alkaline throughout.

Controlling erosion, improving fertility and drainage, selecting adapted plant species, and preventing pollution are concerns in managing these soils. Grading and reshaping commonly are necessary to control runoff. Reseeding also helps to control runoff. In some areas outlet structures are used to control the flow of water into streams. Sediment ponds can be used to trap sediment. In some of the less sloping areas, surface and subsurface drains are installed.

Species that can withstand the neutral to moderately alkaline reaction and low fertility should be selected for planting. Blanketing with topsoil hastens establishment of a plant cover. Mulching seedlings conserves moisture and increases growth rates.

Unless it is controlled, seepage from the included areas of toxic waste can result in the pollution of streams. Uneven settlement can occur in filled areas. Some borrow areas are ponded following periods of heavy rainfall.

The suitability of these soils for building site development depends on the degree of soil compaction and the need for drainage. The soils are generally unsuited to septic tank absorption fields. Onsite investigation is needed to determine the suitability for specific land uses.

No land capability classification or woodland ordination symbol is assigned.

We—Westland clay loam. This deep, nearly level, very poorly drained soil is on stream terraces. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are long and narrow or irregularly shaped and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark gray, friable clay loam about 12 inches thick. The subsoil is about 31 inches thick. The upper part is dark gray and gray, mottled, firm clay loam, and the lower part is dark gray, mottled, firm clay loam and friable, stratified gravelly sandy loam and sandy clay loam. The underlying material to a depth of about 60 inches is dark gray, loose very gravelly loamy coarse sand. In some areas the subsoil has more clay. In other areas the underlying material is sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth and Whitaker soils on slight rises. Also included are areas of soils that are subject to rare flooding. Included soils make up about 10 percent of most mapped areas.

Permeability is moderate in the subsoil of the Westland soil and very rapid in the underlying material. Available water capacity is moderate. Runoff is very slow or ponded. A seasonal high water table is near or above the surface during extended wet periods. Tilth is fair. The surface layer has a high organic matter content. The potential for frost action is high.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. Seasonal wetness and soil compaction are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table. Deepening outlet ditches improves the effectiveness of the subsurface drainage system. In some areas outlets are submerged when the nearby ditches and streams flood. A good drainage system is needed in areas where a no-till system of planting is applied. Limiting fieldwork when the soil is wet minimizes compaction.

The pasture species selected for planting should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. The wetness is a limitation. Planting seedlings that have been transplanted once reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the windthrow hazard. Plant competition in existing stands can be controlled by removing vines and the less desirable trees and shrubs. Also, mowing, spraying, and disking are effective in controlling the competing vegetation during periods when the seedlings are becoming established. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is poorly suited to dwellings and septic tank absorption fields because of the ponding. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. The included soils that are subject to rare flooding should not be selected as building sites. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low strength, ponding, and frost action. Suitable fill material can raise the roads and streets and the septic tank absorption fields above high ponding levels. Sloughing is a hazard in shallow excavations.

The land capability classification is IIw. The woodland ordination symbol is 5W.

WhA—Whitaker loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil generally is on stream terraces and along the shoreline of former glacial lakes. In a few areas it is on ground moraines. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 10 inches thick. The upper part of the subsoil is brown and yellowish brown, mottled, firm loam and clay loam. The lower part to a depth of about 60 inches is light brownish gray and grayish brown, mottled, friable loam and sandy loam. In a few areas the subsoil has less clay.

Included with this soil in mapping are small areas of Bennington, Martinsville, Milford, and Pewamo soils. Bennington soils formed in glacial till in slightly elevated areas on ground moraines. The well drained Martinsville soils are on low knolls on stream terraces and the shoreline of former glacial lakes. The very poorly drained Milford and Pewamo soils are along drainageways and in depressions. Also included are a few areas of soils that are subject to rare flooding and small areas of moderately well drained soils on slight rises. Included soils make up about 15 percent of most mapped areas.

Permeability is moderate in the Whitaker soil. Available water capacity is high. Runoff is slow. Tilth is good. The surface layer has a moderate organic matter content. The potential for frost action is high. A seasonal high

Figure 8.—Harvesting corn on Blount silt loam, 0 to 2 percent slopes. Where drained, this soil meets the requirements for prime farmland.

water table is at a depth of 1 to 3 feet during extended wet periods.

This soil is used mainly as cropland. It is well suited to corn, soybeans, small grain, hay, and pasture. The seasonal wetness is the main management concern. A subsurface drainage system helps to lower the seasonal high water table. In some areas outlets for subsurface drains are submerged when the nearby rivers and streams flood. No-till planting or another system of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. A good drainage system is needed in

areas where a no-till system is applied. Returning crop residue to the soil and adding other organic material improve tilth and fertility.

The pasture species selected for seeding should be those that are tolerant of the wetness. Rotation grazing, proper stocking rates, and deferred grazing when the soil is wet help to keep the pasture in good condition.

A few areas are used as woodland. Plant competition is a management concern. In existing stands it can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to dwellings and poorly suited to septic tank absorption fields. The seasonal wetness is the main limitation affecting these uses. Properly landscaping building sites helps to divert surface water away from foundations. Installing drains at the base of footings and coating the exterior of basement walls help to keep basements dry. In some areas drainage outlets are submerged when the nearby rivers and streams flood. The included soils that are subject to flooding should not be selected as sites for buildings. Artificially draining the soil and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by frost action. Sloughing is a hazard in shallow excavations. Installing perimeter drains around septic tank absorption fields helps to lower the seasonal high water table.

The land capability classification is IIw. The woodland ordination symbol is 3A.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. 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 has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It 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. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 246,000 acres in the survey area, or nearly 95 percent of the total acreage, meets the soil requirements for prime farmland. Most of this acreage is used for corn and soybeans (fig. 8).

A recent trend in land use in some parts of the county has been the loss of some prime farmland 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 less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

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 bedrock, 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.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

John H. Brown, district conservationist, Soil Conservation Service, helped prepare this section.

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

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

The total area of Marion County is about 259,072 acres. Of this total, about 209,000 acres was used for crops and pasture in 1984 (*17*). Most of this acreage was used for soybeans, corn, or winter wheat. Hay and oats were grown to a lesser extent. In 1982, about 69,400 acres was used for corn, 85,300 acres for soybeans, and 33,400 acres for wheat (*5*).

The potential for increased food production is good. Production can be increased by extending the latest crop-production technology to all of the cropland in the county. This soil survey can greatly facilitate the application of such technology.

The paragraphs that follow describe the major management concerns on the cropland and pasture in the county. These concerns are wetness, water erosion, fertility, and tilth.

Wetness is a major management concern on more than 80 percent of the land used for crops and pasture. Some soils are naturally so wet that the production of the crops commonly grown in the county is generally not feasible unless a drainage system is installed. Ponding and a seasonal high water table impede crop growth on very poorly drained soils, such as Latty, Milford, Paulding, and Pewamo. Because these soils dry out and warm up slowly in the spring, tillage and planting are often delayed. Subsurface and surface drains are used to remove excess water and thus allow early spring tillage and planting. Also, subsurface drains increase the depth to which plant roots can penetrate.

Unless drained, somewhat poorly drained soils, such as Bennington, Blount, and Del Rey, are so wet that the growth of most crops is impeded in most years and planting or harvesting is usually delayed. The wetness lowers yields.

The design of surface and subsurface drainage systems varies with the kind of soil. Surface drains remove excess water from the surface. They generally are most effective on soils that have a high content of clay in the subsoil and are slowly permeable or very slowly permeable. Examples are Latty and Paulding soils. Subsurface drains remove excess water within the soil. The effectiveness of these drains depends primarily on the permeability of the soil and the availability of drainage outlets.

A combination of surface and subsurface drains is needed in many areas of very poorly drained soils that are intensively row cropped. Examples are Latty, Milford, Paulding, and Pewamo soils. Drains should be more closely spaced in slowly permeable or very slowly permeable soils than in the more rapidly permeable soils. Finding adequate outlets for subsurface drainage systems is difficult in depressions and on broad flats on till plains and lake plains.

Small areas of wetter soils along drainageways and in swales are commonly included with moderately well drained soils, such as Cardington, Glynwood, and Shinrock, in mapping. A drainage system is needed in some of these wetter areas.

Maintaining a drainage system is more economical than replacing one. Establishing stone chutes and seeding ditchbanks and berms reduce the hazard of streambank erosion and stabilize the banks. Animal guards keep animals from damaging subsurface drains and blocking the flow of water. Replacing broken drains helps to prevent the accumulation of silt, which can block drainage.

Information about the design of the drainage system for each soil in the county is available at the local office of the Marion Soil and Water Conservation District.

Water erosion is a major management concern on about 25 percent of the land in Marion County. It is a hazard in areas where the slope is more than 2 percent, such as areas of Cardington and Shinrock soils and most areas of Glynwood soils. Excessive soil loss decreases the thickness of the original topsoil. As a result, subsoil material is mixed into the plow layer. Crop yields are reduced because of the loss of plant nutrients and a reduced available water capacity in the soil. When subsoil material, which is higher in content of clay than the original surface soil, is mixed into the plow layer, tilling is more difficult and larger applications of fertilizer are needed. Also, the susceptibility to crusting increases. Erosion is especially damaging to soils that have a moderately deep root zone, such as Milton and Fox soils, because it further reduces the thickness of the root zone.

Erosion on farmland commonly increases the amount of sediment in streams. This sediment degrades water quality because it contains organic matter, plant nutrients, herbicides, and insecticides. Removing sediment deposited in stream channels and ditches is costly. Removal generally is required to restore adequate drainage. Control of erosion minimizes the pollution of streams by sediment and improves the water quality for municipal use, for recreation, and for fish and wildlife.

Most erosion-control measures provide a protective ground cover that reduces the runoff rate, increases the rate of water infiltration, and improves tilth. No-till or another system of conservation tillage that leaves crop residue on the surface and a cropping sequence that includes forage crops of grasses and legumes are effective in controlling erosion on most soils. Such soils as Fox, Ockley, and Martinsville are well suited to no-till. A good drainage system is needed if a no-till system of planting is applied on wet soils, such as Blount, Milford, and Pewamo.

Slopes are generally so short and irregular that contour tillage or terracing is not practical on the steeper soils, such as Cardington, Glynwood, and Shinrock. Grassed waterways are effective in controlling runoff and erosion (fig. 9). Natural drainageways are the best sites for waterways because a good channel commonly can be established with a minimum of shaping. The waterways should be wide and flat, so that they can be crossed by farm machinery and can slow the movement of water. Overcrowding the berm of the waterways during tillage often causes gullying.

Soil fertility is naturally low in many of the upland soils that have a light colored surface layer. Generally, these soils are naturally lower in fertility and in organic matter content and more acid than soils having a dark surface layer. Soils on end moraines and stream terraces, such as Bennington, Fox, and Glynwood, are generally lower in natural fertility than other soils in the county. The most fertile soils generally are those on flood plains or in old prairie areas, such as Sloan, Elliott, and Pewamo soils.

On all soils additions of lime and fertilizer should be based on the crop selected for planting and on the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer and lime to be applied.

Fall plowing is generally not a good practice on soils that have a surface layer of light colored silt loam because of crusting during winter and spring. If plowed in the fall, many of these soils are nearly as dense and hard at planting time as they were before they were plowed. Also, soils that have a slope of 2 percent or more are subject to erosion if they are fall plowed.

Tilth commonly deteriorates if soils that have a surface layer of silty clay loam, such as Milford and Pewamo, or of silty clay, such as Latty, are plowed when wet. Plowing when these soils are wet results in the formation of clods. Because of the cloddiness, preparing a good

Figure 9.—A grassed waterway in an area of Pewamo silty clay loam.

seedbed is difficult. Fall plowing of these soils generally results in improved tilth in the spring.

Incorporating crop residue, manure, and other organic material into the surface layer maintains or improves soil structure and minimizes crusting. Incorporated residue that is exposed at the surface provides pathways for the movement of air and water.

Compaction occurs if the soils are worked when wet or if they are subject to heavy traffic or heavy loads. It slows root growth, inhibits air and water movement, increases the likelihood of plowpans in plowed areas, and commonly decreases yields. Compaction can be minimized by tilling the soils at the proper moisture content and by planting deep-rooted legumes and grasses.

Permanent pasture is a minor land use in Marion County. The pastures in the county are mainly in areas of soils that can be used as cropland. Some are in areas of eroded soils that were once cultivated and in narrow strips and irregularly shaped areas on flood plains. Most of the soils in the county are well suited to high-quality permanent pasture, although yields vary widely. Erosion control, a drainage system, additions of lime and fertilizer, and weed control are the major management needs. Also, measures that minimize surface compaction are needed. Examples are proper stocking rates, deferred grazing during wet periods, and pasture rotation.

The species included in seeding mixtures should be based on soil properties and on the desired pasture management system. Mixtures of legumes and grasses have a higher nutrient value than grasses alone. Also, the legumes provide nitrogen for grass growth. Alfalfa and red clover can be seeded on well drained soils, such as Fox, Kendallville, Martinsville, and Ockley. Ladino

clover and alsike clover grow best on the wetter soils, such as Blount, Del Rey, and Pewamo.

The field crops suited to the soils and climate of the survey area include many that are not commonly grown. Corn and soybeans are the main row crops. Wheat and oats are the most commonly grown small grains. Sunflowers, sorghum, rye, barley, and popcorn could be grown, and grass seed could be produced from bromegrass, fescue, timothy, and bluegrass. Also, legume seed from red clover, alsike clover, and alfalfa could be produced. Economic conditions generally determine whether these crops are grown.

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 land capability classification of each map unit also is shown in the table.

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 ensures 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 for those crops.

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 criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include 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 (*15*). Only class and subclass are used in this survey.

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 few limitations that restrict their use.

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

Class III soils have severe limitations that reduce the choice of plants 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, 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" and in the yields table.

Woodland Management and Productivity

Much of Marion County was forested at the time of settlement. Northern red oak, white oak, black oak, hickory, sugar maple, and other native trees grew on the better drained soils. Red maple, beech, white ash, pin oak, and American elm grew on the wetter soils (*9*). As a result of clearing, the acreage of woodland has been reduced to about 9,000 acres, or less than 4 percent of the county (*17*). This acreage occurs chiefly as scattered small woodlots throughout the county. The steepest, wettest, or less accessible parts of the farms have typically remained wooded. Most of the woodland has been cut over, and much of it has been grazed.

The return from the sale of wood products is smaller than that from the sale of other farm products on individual farms, although some good-quality saw logs of northern red oak, white oak, and black walnut are harvested. Woodlots also provide firewood, lumber, edible nuts, wildlife habitat, esthetic value, and protection from strong winds.

Information about forest management is available from the Ohio Department of Natural Resources, Division of Forestry; the Cooperative Extension Service; the Agricultural Stabilization and Conservation Service; and the Soil Conservation Service.

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 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 an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are the depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the

eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site 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.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

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, help to keep 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 ensure 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 the Ohio Department of Natural Resources, Division of Forestry; from local offices of the Soil Conservation Service or the Cooperative Extension Service; or from a commercial nursery.

Recreation

Marion County has many recreational areas. The Big Island Wildlife Area, a 1,900-acre reserve, is in the western part of the county, north of the Scioto River. Approximately 1,400 acres of the Delaware Reservoir Wildlife Area is in the county, east of Waldo. The Killdeer Plains Wildlife Area includes about 260 acres in the northern part of the county. Several private camping areas and sportsmen clubs provide opportunities for a wide range of outdoor activities.

The city of Marion and many of the villages and schools in the county have parks equipped with athletic fields, playground equipment, tennis courts, and swimming pools. The county has several 18-hole golf courses. The recreational areas in the county are on a wide variety of soils.

Additional information about the recreational areas in the county can be obtained from the Marion County Regional Planning Commission and the Marion Area Chamber of Commerce.

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 gentle 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 should be considered.

Paths and trails for hiking and horseback riding 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

R.E. Sturgeon, wildlife area supervisor, Killdeer Plains Wildlife Area, Ohio Department of Natural Resources, Division of Wildlife, helped prepare this section.

Wildlife is an important natural resource in Marion County. The Big Island Wildlife Area near New Bloomington, the Delaware Reservoir Wildlife Area near Waldo, and the Killdeer Plains Wildlife Area northwest of Morral are owned and operated by the Ohio Department of Natural Resources, Division of Wildlife. These areas are available to the public for hunting and fishing.

Cottontail rabbit, bobwhite quail, and ring-necked pheasant were once the most abundant openland game species in the county. The population of these species has decreased greatly, however, because the removal of fence rows and fall plowing have reduced the extent of their habitat and the supply of their winter food. The population of white-tailed deer is moderately high and is increasing. The extent of the habitat for this species has increased because of the availability of pastures and woodlots that are no longer being grazed by cattle or sheep. Furbearers, particularly fox, raccoon, and muskrat, are plentiful, as are fox squirrel and woodchuck. Many different species of nesting and migrant birds also inhabit the county. Ducks and geese are numerous in the wildlife areas and on scattered ponds and wetlands.

If properly managed, all of the soils in the county can provide food and shelter for wildlife. Incorporating openland, wetland, and woodland wildlife habitat into a single area attracts the widest variety of wildlife species to the area.

Habitat for wetland wildlife can be developed in undrained depressions on uplands and in old stream meanders on flood plains. Ponds also can be used as habitat for wetland wildlife. Special plantings help to attract waterfowl.

Habitat for openland wildlife can be developed in eroded areas by planting mixtures of meadow plants and shrubs that provide food and shelter. A good plant cover helps to control erosion in these areas.

Woodlots and windbreaks around farm buildings can provide food and shelter for wildlife if they are made up of suitable species. Creating a special habitat through the use of birdhouses, bird feeders, seed crops, and flowers helps to attract specific songbirds.

Additional information about the development of wildlife habitat can be obtained from the local game protector and the local office of the Cooperative Extension Service or the Soil Conservation Service.

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 (*1*). 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 barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, ragweed, smartweed, 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, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and raspberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. 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, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattails, 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, red 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, herons, 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, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

Building Site Development

Table 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 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, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

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

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

Sanitary Facilities

Table 13 shows the degree and 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, and flooding affect absorption of the effluent. Large stones or bedrock 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 filter the effluent effectively. 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, 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 and bedrock 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, 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 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, terraces and diversions, and grassed waterways.

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

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

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

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

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

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, 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. These results are reported in table 19.

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 (fig. 10). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

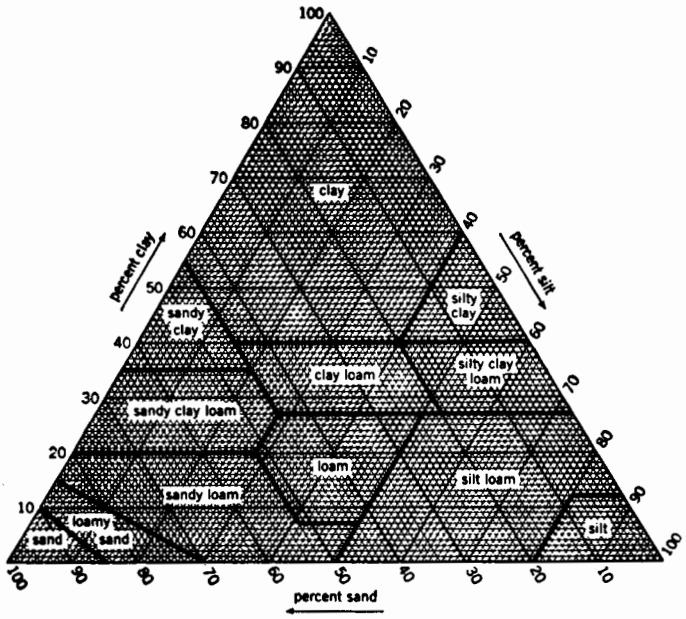

Figure 10.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

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, CL-ML.

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 ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 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 soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. 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 soil blowing 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 soil blowing 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 soil blowing 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 soil blowing are used.
5. Loamy soils that are less than 20 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 soil blowing are used.
6. Loamy soils that are 20 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 soil blowing.

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.

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

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, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, 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 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.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the 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

Many of the soils in Marion County were sampled by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained from most of the samples include particle-size distribution, reaction, organic matter content, and calcium carbonate equivalent.

These data were used in classifying and correlating the soils and in evaluating their behavior under various

land uses. Four pedons were selected as representative of their respective series and are described under the heading "Soil Series and Their Morphology." These series and their laboratory identification numbers are Blount series (MR-7), Glynwood series (MR-5), Latty series (MR-6), and Milford series (MR-4).

In addition to the Marion County data, laboratory data are available from nearby counties in north-central Ohio, which have many of the same soils. Data from these counties and from Marion County are on file at the Department of Agronomy, Ohio State University; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Soil Conservation Service, State Office, Columbus, Ohio.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*16*). 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. Table 20 shows the classification of the soils in the survey area. 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 Alfisol.

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 Aqualf (*Aqu*, meaning water, plus *alf*, from Alfisol).

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 Ochraqualf (*Ochr*, meaning light colored surface layer, plus *aqualf*, the suborder of the Alfisols that has 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 *Aeric* identifies the subgroup that is drier than the typical great group. An example is Aeric Ochraqualfs.

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, mesic Aeric Ochraqualfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material 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* (*14*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*16*). 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."

Bennington Series

The Bennington series consists of deep, somewhat poorly drained, slowly permeable soils in slightly dissected areas on ground moraines. These soils formed in loamy glacial till. Slope ranges from 0 to 3 percent.

Bennington soils are similar to Blount, Del Rey, and Elliott soils and are commonly adjacent to Cardington and Pewamo soils. Blount soils typically have a subsoil that is less acid than that of the Bennington soils. Cardington soils are moderately well drained and are on low knolls and side slopes. Del Rey soils have a lower content of coarse fragments throughout than the

Bennington soils. Elliott soils have a mollic epipedon. Pewamo soils are very poorly drained and are on broad flats, in depressions, and along drainageways.

Typical pedon of Bennington silt loam, 0 to 3 percent slopes, in an area of Tully Township about 0.7 mile west of Martel; about 990 feet west and 1,320 feet south of the northeast corner of sec. 29, T. 4 S., R. 17 E.

Ap—0 to 11 inches; dark grayish brown (2.5Y 4/2) silt loam, light gray (2.5Y 7/2) dry; weak fine and very fine granular structure; friable; common very fine roots; few coarse fragments; slightly acid; abrupt smooth boundary.

BE—11 to 13 inches; yellowish brown (10YR 5/6) silty clay loam; common medium prominent gray (10YR 6/1) and few medium distinct brown (10YR 5/3) mottles; moderate medium and fine subangular blocky structure; firm; few fine and very fine roots; many distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few faint grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; strongly acid; abrupt wavy boundary.

Bt1—13 to 18 inches; brown (10YR 5/3) silty clay loam; common coarse distinct yellowish brown (10YR 5/6) and common medium distinct gray (10YR 6/1) mottles; moderate medium angular blocky structure; firm; few fine and very fine roots; many faint grayish brown (2.5Y 5/2) clay films on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt2—18 to 31 inches; yellowish brown (10YR 5/6) clay loam; many medium prominent grayish brown (10YR 5/2) and few medium faint yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure parting to moderate coarse angular blocky; firm; few very fine roots; many faint dark grayish brown (10YR 4/2) clay films on faces of peds; few coarse fragments; strongly acid in the upper part grading to neutral in the lower part; clear wavy boundary.

BC—31 to 36 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; friable; few very fine roots; very few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—36 to 56 inches; brown (10YR 4/3) loam; common medium distinct gray (10YR 5/1) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; common distinct gray (10YR 5/1) coatings in vertical seams; common prominent light gray (10YR 6/1) carbonate coatings in vertical seams; about 5 percent coarse fragments; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—56 to 60 inches; yellowish brown (10YR 5/4) clay loam; common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; common distinct gray (10YR 5/1) coatings in vertical seams; common prominent light gray (10YR 6/1) carbonate coatings in vertical seams; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 31 to 48 inches. The depth to carbonates ranges from 29 to 43 inches. The content of coarse fragments is 1 to 5 percent in the solum and 2 to 10 percent in the C horizon.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, 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. It is silty clay loam or clay loam. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is clay loam, silty clay loam, or loam.

Blount Series

The Blount series consists of deep, somewhat poorly drained, slowly permeable or moderately slowly permeable soils on ground moraines and end moraines. These soils formed in loamy glacial till that has a high content of lime. Slope ranges from 0 to 6 percent.

Blount soils are similar to Bennington, Del Rey, and Elliott soils and are commonly adjacent to Glynwood and Pewamo soils. Bennington soils typically are more acid in the subsoil than the Blount soils. Del Rey soils have fewer coarse fragments throughout than the Blount soil. Elliott soils have a mollic epipedon. Glynwood soils are moderately well drained and are on side slopes and on low ridges and knolls. Pewamo soils are very poorly drained and are on broad flats, in depressions, and along drainageways.

Typical pedon of Blount silt loam, 0 to 2 percent slopes, in an area of Claridon Township about 2.7 miles west-southwest of Claridon; about 2,300 feet east and 1,800 feet north of the southwest corner of sec. 29, T. 5 S., R. 16 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; common fine and very fine roots; neutral; abrupt smooth boundary.

Bt—11 to 14 inches; brown (10YR 5/3) silty clay; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure; firm; few fine and very fine roots; few faint grayish brown (10YR 5/2) clay films on faces of peds; many faint grayish brown (10YR 5/2) silt coatings on faces of peds; few

coarse fragments; slightly acid; clear smooth boundary.

Btg—14 to 20 inches; grayish brown (10YR 5/2) silty clay; many medium prominent yellowish brown (10YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few very fine roots; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

B't—20 to 26 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate coarse and medium subangular blocky structure; firm; few very fine roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few coarse fragments; mildly alkaline; clear wavy boundary.

BC—26 to 32 inches; brown (10YR 5/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and common medium distinct gray (10YR 5/1) mottles; moderate coarse subangular blocky structure; firm; few very fine roots; very few faint dark grayish brown (10YR 4/2) clay films on vertical faces of peds; few coarse fragments; slight effervescence; moderately alkaline; gradual wavy boundary.

C—32 to 60 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 45 inches. The depth to carbonates ranges from 21 to 40 inches. The content of coarse fragments is 0 to 5 percent in the solum and 2 to 10 percent in the C horizon.

The Ap horizon has chroma of 2 or 3. The Bt, Btg, and B't horizons have value of 4 or 5 and chroma of 2 to 4. They are clay loam, silty clay loam, silty clay, or clay. The C horizon has value of 4 or 5 and chroma of 2 to 6. It is silty clay loam or clay loam.

Cardington Series

The Cardington series consists of deep, moderately well drained, moderately slowly permeable soils on ground moraines. These soils formed in loamy glacial till. Slope ranges from 2 to 12 percent.

Cardington soils are similar to Centerburg, Glynwood, and Shinrock soils and are commonly adjacent to Bennington and Pewamo soils. Bennington soils are somewhat poorly drained and are in slightly dissected areas on ground moraines. Centerburg soils have less clay in the subsoil than the Cardington soils. Glynwood soils are less acid in the subsoil than the Cardington soils. Pewamo soils have a mollic epipedon. They are very poorly drained and are on broad flats, in depressions, and along drainageways. Shinrock soils have fewer coarse fragments throughout than the Cardington soils.

Typical pedon of Cardington silt loam, 2 to 6 percent slopes, in an area of Tully Township about 1.3 miles southeast of Martel; about 2,640 feet west and 740 feet south of the northeast corner of sec. 34, T. 4 S., R. 17 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine and very fine granular structure; friable; few fine and very fine roots; few coarse fragments; strongly acid; abrupt smooth boundary.

Bt1—9 to 12 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few fine and very fine roots; few faint brown (10YR 5/3) clay films on faces of peds; common faint brown (10YR 5/3) silt coatings on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt2—12 to 17 inches; yellowish brown (10YR 5/4) silty clay; common medium faint yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few fine and very fine roots; few faint brown (10YR 4/3) clay films on faces of peds; common faint brown (10YR 5/3) silt coatings on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt3—17 to 26 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine and very fine roots; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; many distinct brown (10YR 5/3) silt coatings on faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); few coarse fragments; medium acid; clear wavy boundary.

Bt4—26 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; many distinct grayish brown (10YR 5/2) silt coatings on faces of peds; many fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; slightly acid; gradual wavy boundary.

C1—29 to 36 inches; brown (10YR 4/3) clay loam; common coarse distinct yellowish brown (10YR 5/6) and many medium distinct grayish brown (10YR 5/2)

mottles; weak coarse subangular blocky structure; firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—36 to 60 inches; brown (10YR 4/3) clay loam; common coarse distinct yellowish brown (10YR 5/6) and many medium distinct grayish brown (10YR 5/2) mottles; massive; firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum typically ranges from 28 to 40 inches. In eroded areas, however, it ranges from 22 to 34 inches. The depth to carbonates ranges from 26 to 34 inches. The content of coarse fragments is 1 to 8 percent in the solum and 2 to 10 percent in the C horizon.

The Ap horizon has value of 4 or 5. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is silty clay, silty clay loam, or clay loam. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is silty clay loam, loam, or clay loam.

Centerburg Series

The Centerburg series consists of deep, moderately well drained, moderately slowly permeable soils on ground moraines and end moraines. These soils formed in loamy glacial till. Slope ranges from 1 to 4 percent.

Centerburg soils are similar to Cardington and Glynwood soils and are commonly adjacent to Milford soils. Cardington and Glynwood soils have more clay in the subsoil than the Centerburg soils. Milford soils are very poorly drained and are on broad flats, in shallow depressions, and along drainageways.

Typical pedon of Centerburg silt loam, 1 to 4 percent slopes, in an area of Scott Township about 2.5 miles south-southwest of Kirkpatrick; about 1,400 feet south and 2,520 feet west of the northeast corner of sec. 33, T. 4 S., R. 16 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and very fine granular structure; friable; common fine and medium roots; medium acid; few coarse fragments; abrupt smooth boundary.

Bt1—9 to 14 inches; yellowish brown (10YR 5/6) clay loam; moderate medium distinct brown (10YR 5/3) mottles; moderate fine subangular blocky structure; firm; common fine and very fine roots; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common faint yellowish brown (10YR 5/4) silt coatings on faces of peds; few distinct brown (10YR 4/3) organic coatings on faces of peds; few coarse fragments; medium acid; clear wavy boundary.

Bt2—14 to 18 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct yellowish brown (10YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure; firm; few fine and very fine roots; common distinct brown (10YR 5/3) clay films and silt coatings on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt3—18 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct dark grayish brown (10YR 4/2) and few medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few very fine roots; common distinct brown (10YR 4/3) clay films on faces of peds; about 10 percent coarse fragments; neutral; clear wavy boundary.

BC—24 to 37 inches; brown (10YR 5/3) clay loam; common medium distinct yellowish brown (10YR 5/6) and common coarse distinct gray (10YR 5/1) mottles; weak medium and thick platy structure; firm; few coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C—37 to 60 inches; brown (10YR 5/3) loam; common coarse distinct yellowish brown (10YR 5/6) and common coarse distinct gray (10YR 5/1) mottles; massive; firm; gray (N 6/0) vertical and horizontal seams; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 50 inches. The content of coarse fragments is 0 to 5 percent in the solum and 2 to 10 percent in the C horizon.

The Ap horizon has chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is silty clay loam or clay loam. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or loam.

Del Rey Series

The Del Rey series consists of deep, somewhat poorly drained, slowly permeable soils on lake plains. These soils formed in stratified lacustrine sediments. Slope ranges from 0 to 3 percent.

Del Rey soils are similar to Bennington and Blount soils and are commonly adjacent to Milford and Shinrock soils. Bennington and Blount soils have coarse fragments throughout the solum. Milford soils are very poorly drained and are on broad flats, in depressions, and along drainageways. Shinrock soils are moderately well drained and are on low knolls and side slopes.

Typical pedon of Del Rey silt loam, 0 to 3 percent slopes, in an area of Salt Rock Township about 3 miles south-southwest of Morral; about 159 feet east and 1,980 feet north of the southwest corner of sec. 34, T. 4 S., R. 14 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine

and very fine granular structure; friable; common fine and very fine roots; few medium black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; abrupt wavy boundary.

Bt1—11 to 16 inches; yellowish brown (10YR 5/6) silty clay loam; few fine prominent grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure; firm; common fine and very fine roots; few faint brown (10YR 4/3) clay films in pores; many distinct grayish brown (10YR 5/2) silt coatings on faces of peds; few medium black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

Bt2—16 to 28 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine and very fine roots; stratified with silty clay in the lower part; common faint dark grayish brown (10YR 4/2) clay films on vertical faces of peds; many distinct grayish brown (10YR 5/2) silt coatings on faces of peds; common medium black (10YR 2/1) concretions (iron and manganese oxides); slightly acid; clear wavy boundary.

BC—28 to 32 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct gray (10YR 5/1) and common medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine and very fine roots; very few faint dark grayish brown (10YR 4/2) clay films on vertical faces of peds; many distinct dark grayish brown (10YR 4/2) silt coatings on faces of peds; few medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

C—32 to 60 inches; dark yellowish brown (10YR 4/4) silt loam that has thin strata of fine sandy loam; common coarse distinct yellowish brown (10YR 5/6) and common coarse distinct gray (10YR 5/1) mottles; massive; friable; common medium black (10YR 2/1) concretions (iron and manganese oxides); slight effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 46 inches. It is commonly the same as the depth to carbonates.

The Bt horizon has value of 4 to 6 and chroma of 2 to 6. It is silty clay loam or silty clay. The C horizon has value of 4 to 6 and chroma of 2 to 8. It is dominantly silt loam or silty clay loam. In many pedons, however, it is stratified with fine sandy loam or silty clay.

Elliott Series

The Elliott series consists of deep, somewhat poorly drained, moderately slowly permeable or slowly permeable soils on ground moraines. These soils formed in loamy glacial till that has a high content of lime. Slope ranges from 0 to 3 percent.

The Elliott soils are similar to Bennington and Blount soils and are commonly adjacent to Blount and Pewamo soils. Bennington and Blount soils have an ochric epipedon. They are in the higher landscape positions. Pewamo soils are very poorly drained and are on broad flats, in depressions, and along drainageways.

Typical pedon of Elliott silty clay loam, 0 to 3 percent slopes, in an area of Claridon Township about 0.9 mile southwest of Claridon; about 660 feet west and 750 feet north of the southeast corner of sec. 28, T. 5 S., R. 16 E.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; firm; few fine roots; neutral; abrupt wavy boundary.

Bt1—12 to 17 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct dark gray (10YR 4/1) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse and medium subangular blocky structure; firm; few fine and very fine roots; common faint dark gray (10YR 4/1) clay films on faces of peds; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few coarse fragments; medium acid; clear wavy boundary.

Bt2—17 to 25 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct dark gray (10YR 4/1) and few fine faint yellowish brown (10YR 5/6) mottles; moderate coarse and medium subangular blocky structure; firm; few fine and very fine roots; many faint dark gray (10YR 4/1) clay films on faces of peds; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few coarse fragments; medium acid; clear wavy boundary.

BC—25 to 37 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct gray (10YR 5/1) and few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse subangular blocky structure grading to weak coarse subangular blocky in the lower part; firm; few very fine roots; very few faint dark grayish brown (10YR 4/2) clay films on faces of peds; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) clay loam; many coarse distinct gray (10YR 5/1) mottles; massive; firm; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 45 inches. The thickness of the mollic epipedon ranges from 10 to 17 inches. The content of coarse fragments is

0 to 5 percent in the solum and 5 to 10 percent in the C horizon.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bt and C horizons have value of 4 or 5 and chroma of 2 to 4. The Bt horizon is silty clay loam, clay loam, or silty clay. The C horizon is silty clay loam or clay loam.

Fitchville Series

The Fitchville series consists of deep, somewhat poorly drained, moderately slowly permeable soils on stream terraces. These soils formed in old alluvium. Slope ranges from 0 to 3 percent.

Fitchville soils are similar to Whitaker soils and are commonly adjacent to Fox, Milford, and Sloan soils. Fox soils are well drained and are in the higher landscape positions. Milford and Sloan soils are very poorly drained. Sloan soils are on flood plains, and Milford soils are on broad flats, in depressions, and along drainageways. Whitaker soils have more sand throughout than the Fitchville soils.

Typical pedon of Fitchville silt loam, 0 to 3 percent slopes, in an area of Green Camp Township about 0.6 mile south of Green Camp; about 2,475 feet north of the intersection of Kirts Road (Township Road 79) and Prospect-Upper Sandusky Road (Township Road 83), along Prospect-Upper Sandusky Road, then 1,155 feet east:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; moderate fine granular structure; friable; common fine and very fine roots; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; abrupt smooth boundary.

BE—10 to 12 inches; yellowish brown (10YR 5/6) silt loam; many medium faint yellowish brown (10YR 5/4) and few medium prominent grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; common fine and very fine roots; common distinct light yellowish brown (10YR 6/4) silt coatings on faces of peds; few distinct brown (10YR 5/3) organic coatings on faces of peds; common fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

Bt1—12 to 21 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) and common fine prominent grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; many distinct grayish brown (10YR 5/2) silt coatings on faces of peds; common medium black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Bt2—21 to 34 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; many distinct grayish brown (10YR 5/2) silt coatings on faces of peds; common medium black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

BC—34 to 43 inches; dark yellowish brown (10YR 4/4) silt loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; very few distinct grayish brown (10YR 5/2) clay films on faces of peds; common distinct grayish brown (10YR 5/2) silt coatings on faces of peds; common medium black (10YR 2/1) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

C—43 to 60 inches; olive brown (2.5Y 4/4) stratified silt loam and silty clay loam; common medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; massive; friable; common medium black (10YR 2/1) concretions (iron and manganese oxides); slightly acid.

The thickness of the solum ranges from 41 to 55 inches. The Ap horizon has value of 4 or 5. The Bt horizon has value of 4 or 5 and chroma of 2 to 6. It is silt loam or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is laminated or stratified and is silt loam or silty clay loam.

Fox Series

The Fox series consists of deep, well drained soils that generally are on stream terraces but in a few areas are on the hummocky parts of moraines. These soils formed in loamy glacial outwash and in the underlying stratified, calcareous sand and gravel at a depth of 20 to 40 inches. Permeability is moderate in the solum and rapid or very rapid in the underlying material. Slope ranges from 0 to 6 percent.

Fox soils are commonly adjacent to Nolin, Sloan, and Westland soils. Nolin soils have more silt throughout than the Fox soils. Sloan and Westland soils are very poorly drained. Nolin and Sloan soils are on flood plains. Westland soils are on broad flats, in depressions, and along drainageways.

Typical pedon of Fox loam, 2 to 6 percent slopes, in an area of Waldo Township about 0.9 mile southeast of Waldo; about 3,380 feet west of the intersection of Prospect-Mt. Vernon Road (Township Road 86) and

Gearhiser Road (Township Road 142), along Prospect-Mt. Vernon Road, then 1,400 feet south:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine and very fine granular structure; very friable; common fine and very fine roots; about 5 percent coarse fragments; neutral; abrupt wavy boundary.

Bt1—8 to 17 inches; dark brown (7.5YR 4/4) clay loam; weak medium subangular blocky structure; firm; few fine and very fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of peds; about 10 percent coarse fragments; neutral; clear wavy boundary.

Bt2—17 to 29 inches; dark brown (7.5YR 4/4) gravelly clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and very fine roots; common distinct dark brown (7.5YR 4/4) clay films on faces of peds; about 20 percent coarse fragments; neutral; abrupt wavy boundary.

2C1—29 to 39 inches; brown (10YR 4/3) very gravelly coarse sand; single grained; loose; common medium prominent light yellowish brown (10YR 6/4) soft accumulations of calcium carbonate; about 50 percent coarse fragments (about 10 percent cobblestones and 40 percent gravel); strong effervescence; moderately alkaline; abrupt irregular boundary.

2C2—39 to 60 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grained; loose; about 25 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. It is about the same as the depth to carbonates. The content of coarse fragments commonly ranges from 2 to 25 percent in the Bt horizon; however, it can be as much as 50 percent in individual subhorizons. It ranges from 5 to 60 percent in the 2C horizon.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. It is dominantly loam, clay loam, or the gravelly analogs of these textures. In some pedons, however, it has thin subhorizons of sandy clay loam or sandy loam in the lower part. The 2C horizon has value of 4 or 5 and chroma of 2 to 4. It is sand, coarse sand, or the gravelly or very gravelly analogs of these textures.

Fulton Series

The Fulton series consists of deep, somewhat poorly drained, slowly permeable or very slowly permeable soils on lake plains. These soils formed in calcareous lacustrine sediments. Slope ranges from 0 to 6 percent.

Fulton soils are commonly adjacent to Latty soils. Latty soils are very poorly drained and are on broad flats.

Typical pedon of Fulton silty clay loam, 0 to 2 percent slopes, in an area of Big Island Township about 1.5 miles southwest of Big Island; about 1,570 feet west and 900 feet north of the southeast corner of sec. 22, T. 5 S., R. 14 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak medium and fine subangular blocky structure; few very fine roots; firm; slightly acid; abrupt smooth boundary.

Bt1—10 to 32 inches; brown (10YR 5/3) silty clay; common medium distinct yellowish brown (10YR 5/8) and common medium distinct gray (10YR 5/1) mottles; moderate medium and fine subangular blocky structure; very firm; few very fine roots; few faint brown (10YR 5/3) clay films on faces of peds; many distinct gray (10YR 5/1) silt coatings on faces of peds; strongly acid; clear wavy boundary.

Bt2—32 to 37 inches; dark yellowish brown (10YR 4/4) silty clay; many medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; very firm; few very fine roots; few faint grayish brown (10YR 5/2) clay films on faces of peds; neutral; abrupt smooth boundary.

C1—37 to 48 inches; brown (10YR 5/3) silty clay; common medium faint light brownish gray (10YR 6/2) and yellowish brown (10YR 5/4) mottles; massive; very firm; strong effervescence; moderately alkaline; clear smooth boundary.

C2—48 to 60 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct yellowish brown (10YR 5/6) and common medium faint brown (10YR 5/3) mottles; massive; very firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. It is about the same as the depth to carbonates. The content of coarse fragments is 0 to 5 percent in the Ap horizon.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is commonly clay or silty clay, but it has thin strata of silty clay loam in some pedons. The C horizon has hue of 10YR or 2.5Y, value or 4 or 5, and chroma of 2 to 4. It is commonly silty clay, clay, or silty clay loam, but it has thin strata of silt loam or fine sandy loam in some pedons.

Glynwood Series

The Glynwood series consists of deep, moderately well drained, slowly permeable soils on end moraines and ground moraines. These soils formed in glacial till that has a high content of lime. Slope ranges from 0 to 18 percent.

Glynwood soils are similar to Cardington, Centerburg, and Shinrock soils and are commonly adjacent to Blount and Pewamo soils. Blount soils are somewhat poorly drained soils and are on slight rises and in gently undulating areas. Cardington soils are more acid in the subsoil than the Glynwood soils. Centerburg soils have less clay in the subsoil than the Glynwood soils. Pewamo soils have a mollic epipedon. They are very poorly drained and are on broad flats, in depressions, and along drainageways. Shinrock soils have fewer coarse fragments throughout than the Glynwood soils.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, in an area of Marion Township about 2 miles south of Marion; about 1,250 feet east and 1,550 feet north of the southwest corner of sec. 34, T. 5 S., R. 15 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure; friable; few fine and very fine roots; few coarse fragments; slightly acid; abrupt wavy boundary.

Bt1—9 to 16 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few very fine roots; common faint dark yellowish brown (10YR 4/4) clay films on faces of peds; common distinct yellowish brown (10YR 5/4) silt coatings on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt2—16 to 24 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few very fine roots; common prominent dark brown (10YR 3/3) clay films on faces of peds; many distinct dark yellowish brown (10YR 4/4) silt coatings on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

BC—24 to 29 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few very fine roots; very few distinct brown (10YR 4/3) clay films on vertical faces of peds; common faint brown (10YR 5/3) silt coatings on faces of peds; few coarse fragments; slight effervescence; moderately alkaline; gradual wavy boundary.

C—29 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; common prominent gray (10YR 5/1) and light gray (10YR 6/1) lime coatings in vertical seams; common fine light gray (10YR 6/1) lime concretions; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 40 inches. The depth to carbonates ranges from 12 to 36 inches.

The Ap horizon has value of 4 or 5 and chroma of 3 or 4. Some pedons have an A horizon, which has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is clay loam, clay, silty clay, or silty clay loam. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or clay loam.

Kendallville Series

The Kendallville series consists of deep, well drained, moderately slowly permeable soils that generally are on stream terraces but in some areas are on the hummocky parts of moraines. These soils formed in glacial outwash over glacial till. Slope ranges from 2 to 18 percent.

Kendallville soils are commonly adjacent to Glynwood, Medway, and Ockley soils. Glynwood soils are moderately well drained and are on low knolls and side slopes in the uplands. They have more clay in the subsoil than the Kendallville soils. Medway soils are moderately well drained and are on the lower parts of the stream terraces. Ockley soils are coarser textured in the underlying material than the Kendallville soils. They are on the slightly lower parts of the terraces.

Typical pedon of Kendallville loam, 2 to 6 percent slopes, in an area of Waldo Township about 0.7 mile north of Waldo; about 660 feet south of the intersection of State Route 98 and Donithen Road (Township Road 139), along State Route 98, then west 100 feet:

Ap—0 to 9 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure; friable; few fine and very fine roots; few coarse fragments; neutral; abrupt smooth boundary.

Bt1—9 to 19 inches; dark brown (7.5YR 4/4) clay loam; weak medium subangular blocky structure; firm; few fine and very fine roots; common faint dark brown (7.5YR 4/4) clay films on faces of peds; about 5 percent coarse fragments; medium acid; clear wavy boundary.

Bt2—19 to 30 inches; dark brown (7.5YR 4/4) gravelly clay loam; weak medium subangular blocky structure; firm; few fine and very fine roots; common distinct dark brown (7.5YR 4/2) clay films on faces of peds; about 20 percent coarse fragments; medium acid; clear wavy boundary.

Bt3—30 to 40 inches; brown (10YR 4/3) gravelly clay loam; few medium distinct brown (7.5YR 5/4) mottles; weak coarse subangular blocky structure;

firm; few fine and very fine roots; common distinct dark reddish brown (5YR 3/2) clay films on faces of peds; about 30 percent coarse fragments; neutral; gradual wavy boundary.

2C—40 to 60 inches; brown (10YR 5/3) silt loam; common medium distinct light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; common prominent white (10YR 8/2) calcium carbonate coatings along vertical cleavage planes; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 27 to 40 inches. The thickness of the glacial outwash ranges from 18 to 40 inches. The depth to carbonates ranges from 25 to 40 inches. The content of coarse fragments is 5 to 30 percent in the Bt horizon and 2 to 10 percent in the 2C horizon.

The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, loam, or gravelly clay loam. The 2C horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam, clay loam, or loam.

Latty Series

The Latty series consists of deep, very poorly drained, very slowly permeable soils on lake plains. These soils formed in clayey lacustrine sediments. Slope is 0 to 2 percent.

Latty soils are similar to Paulding soils and are commonly adjacent to Fulton and Milford soils. Fulton soils are somewhat poorly drained and are on slight rises. Milford soils have a mollic epipedon and have less clay in the subsoil than the Latty soils. They are in depressions and along the fringes of areas of the Latty soils. Paulding soils have more clay in the subsoil than the Latty soils.

Typical pedon of Latty silty clay, in an area of Big Island Township about 1.6 miles east-southeast of New Bloomington; about 700 feet west and 1,300 feet north of the southeast corner of sec. 30, T. 5 S., R. 14 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay, light brownish gray (10YR 6/2) dry; moderate medium and fine subangular blocky structure; firm; common fine and very fine roots; slightly acid; abrupt smooth boundary.

Bg1—7 to 19 inches; dark gray (5Y 4/1) silty clay; common medium prominent olive brown (2.5Y 4/4) and common medium prominent light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure; very firm; few fine and very fine roots; few dark grayish brown (10YR 4/2) krotovinas; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

Bg2—19 to 25 inches; gray (5Y 5/1) silty clay; common medium prominent olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/6) mottles; moderate medium angular blocky structure; very firm; few very fine roots; few dark grayish brown (10YR 4/2) krotovinas; few fine black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

Bg3—25 to 37 inches; gray (5Y 6/1) silty clay; common medium prominent light olive brown (2.5Y 5/6) mottles; moderate coarse and medium subangular blocky structure; firm; few very fine roots; few dark grayish brown (10YR 4/2) krotovinas; few fine black (10YR 2/1) concretions (iron and manganese oxides); mildly alkaline; gradual wavy boundary.

Bg4—37 to 49 inches; gray (5Y 6/1) silty clay; common medium prominent light olive brown (2.5Y 5/6) mottles; weak coarse subangular blocky structure; firm; few very fine roots; few dark grayish brown (10YR 4/2) krotovinas; few fine black (10YR 2/1) concretions (iron and manganese oxides); mildly alkaline; gradual wavy boundary.

Cg—49 to 60 inches; gray (5Y 5/1) silty clay; many medium prominent olive brown (2.5Y 4/4) and many medium prominent light olive brown (2.5Y 5/6) mottles; massive; firm; few fine black (10YR 2/1) concretions (iron and manganese oxides); few medium light gray (10YR 7/2) calcium carbonate nodules; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 45 to 55 inches. The Ap horizon has hue of 10YR or 2.5Y and chroma of 1 or 2. The Bg and C horizons are clay or silty clay. The Bg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. The C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 4.

Martinsville Series

The Martinsville series consists of deep, well drained, moderately permeable soils that generally are on stream terraces and along the shoreline of former glacial lakes but in a few areas are on uplands. These soils formed in loamy glacial outwash. Slope ranges from 0 to 6 percent.

Martinsville soils are similar to Ockley soils and are commonly adjacent to Nolin, Sloan, and Whitaker soils. Ockley soils have a higher content of coarse fragments in the subsoil and underlying material than the Martinsville soils. Nolin and Sloan soils are on flood plains. Nolin soils have more silt throughout than the Martinsville soils. Sloan soils are very poorly drained. They have a mollic epipedon. Whitaker soils are somewhat poorly drained and are in the lower landscape positions.

Typical pedon of Martinsville loam, 0 to 2 percent slopes, in an area of Grand Prairie Township about 1.8

miles south-southwest of Brush Ridge; about 2,285 feet east and 1,000 feet north of the southwest corner of sec. 29, T. 4 S., R. 15 E.

Ap—0 to 10 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; few fine and very fine roots; few coarse fragments; medium acid; abrupt wavy boundary.

Bt1—10 to 24 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; firm; few very fine roots; few faint brown (10YR 4/3) clay films on faces of peds; common distinct brown (10YR 4/3) organic coatings on faces of peds; few coarse fragments; strongly acid; gradual wavy boundary.

Bt2—24 to 32 inches; dark yellowish brown (10YR 4/4) loam; moderate coarse and medium subangular blocky structure; firm; few very fine roots; few distinct brown (10YR 4/3) clay films on faces of peds; few distinct brown (10YR 4/3) organic coatings on faces of peds; few coarse fragments; strongly acid; gradual wavy boundary.

Bt3—32 to 44 inches; yellowish brown (10YR 5/6) sandy loam; weak coarse subangular blocky structure; friable; few very fine roots; few faint dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; thin strata of sandy clay loam; few dark brown (7.5YR 4/4) iron stains on faces of peds; strongly acid; clear wavy boundary.

BC—44 to 70 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; massive; very friable; dark brown (7.5YR 4/4) bodies of sandy clay loam having clay bridges between sand grains; strongly acid in the upper part grading to medium acid in the lower part.

The thickness of the solum ranges from 40 to more than 70 inches. The content of coarse fragments is 0 to 10 percent throughout the profile.

The Bt and BC horizons have value of 4 or 5 and chroma of 3 to 6. The Bt horizon is clay loam, loam, sandy loam, or sandy clay loam. The BC horizon is loam or sandy loam.

Medway Series

The Medway series consists of deep, moderately well drained, moderately permeable soils on low stream terraces. These soils formed in loamy alluvium. Slope is 0 to 2 percent.

Medway soils are commonly adjacent to Glynwood, Kendallville, and Ockley soils. Glynwood and Kendallville soils are on side slopes. They are underlain by glacial till. Ockley soils have a higher content of coarse fragments in the underlying material than the Medway soils. They are well drained and are on slight rises.

Typical pedon of Medway clay loam, rarely flooded, in an area of Pleasant Township about 3.6 miles southeast of downtown Marion; about 1,311 feet east and 651 feet south of the northwest corner of sec. 11, T. 6 S., R. 15 E.

Ap—0 to 11 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; firm; common fine and very fine roots; few coarse fragments; neutral; clear smooth boundary.

A—11 to 15 inches; black (10YR 2/1) clay loam, gray (10YR 5/1) dry; moderate medium angular blocky structure; firm; common fine and very fine roots; few coarse fragments; neutral; clear wavy boundary.

Bw1—15 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to moderate fine angular blocky; firm; common fine and very fine roots; common distinct grayish brown (10YR 5/2) silt coatings on faces of peds; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; few black (10YR 2/1) krotovinas; few medium black (10YR 2/1) concretions (iron and manganese oxides); few coarse fragments; neutral; clear wavy boundary.

Bw2—27 to 44 inches; olive brown (2.5Y 4/4) clay loam; many medium distinct gray (10YR 5/1) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate coarse subangular blocky; very firm; few very fine roots; many distinct dark gray (10YR 4/1) silt coatings on faces of peds; few black (10YR 2/1) krotovinas; few medium black (10YR 2/1) concretions (iron and manganese oxides); few coarse fragments; slightly acid; clear wavy boundary.

BC—44 to 50 inches; yellowish brown (10YR 5/6) loam; many medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure; firm; few very fine roots; common distinct gray (10YR 5/1) silt coatings on faces of peds; few black (10YR 2/1) krotovinas; few medium black (10YR 2/1) concretions (iron and manganese oxides); few coarse fragments; neutral; gradual wavy boundary.

C—50 to 60 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct dark gray (10YR 4/1) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; about 5 percent coarse fragments; neutral.

The thickness of the solum ranges from 43 to 50 inches. The thickness of the mollic epipedon ranges from 10 to 18 inches. The content of coarse fragments is 0 to 10 percent in the solum and 0 to 25 percent in the C horizon.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is clay loam, loam, or silty clay loam. The C horizon has value of 4 or 5 and chroma of 1 to 6. It is dominantly sandy loam, loam, clay loam, or the gravelly analogs of these textures. In some pedons, however, it has strata of silt loam.

Milford Series

The Milford series consists of deep, very poorly drained, moderately slowly permeable soils on lake plains. These soils formed in stratified, calcareous lacustrine sediments. Slope is 0 to 2 percent.

Milford soils are commonly adjacent to Centerburg, Del Rey, Saranac, and Shinrock soils. Centerburg soils are moderately well drained and are on slight rises and low knolls on till plains. Del Rey soils are somewhat poorly drained and are on slight rises on lake plains. Saranac soils irregularly decrease in content of organic matter with increasing depth. They are on flood plains. Shinrock soils are moderately well drained and are on low knolls and side slopes on lake plains.

Typical pedon of Milford silty clay loam, in an area of Salt Rock Township about 2.8 miles northeast of Big Island; about 600 feet west and 1,650 feet north of the southeast corner of sec. 33, T. 4 S., R. 14 E.

Ap—0 to 13 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium and fine subangular blocky structure; firm; few very fine roots; neutral; clear wavy boundary.

Bg1—13 to 18 inches; dark gray (N 4/0) silty clay loam; common medium prominent olive brown (2.5Y 4/4) and few fine prominent light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few very dark gray (10YR 3/1) krotovinas; neutral; clear wavy boundary.

Bg2—18 to 32 inches; gray (N 5/0) silty clay loam; common medium prominent olive brown (2.5Y 4/4) and common medium prominent light olive brown (2.5Y 5/4) mottles; moderate medium angular blocky structure; firm; few very fine roots; few very dark gray (10YR 3/1) krotovinas; neutral; gradual wavy boundary.

Bg3—32 to 47 inches; gray (N 5/0) silty clay loam; common medium prominent light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; firm; few very fine roots; thin strata of silty clay; few very dark gray (10YR 3/1) krotovinas; mildly alkaline; gradual wavy boundary.

Cg—47 to 60 inches; gray (N 5/0) silty clay loam; common medium prominent light olive brown (2.5Y 5/6) and few medium prominent olive brown (2.5Y 4/4) mottles; massive; firm; thin strata of silt loam and silty clay; few very dark gray (10YR 3/1) krotovinas; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 12 to 17 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is silty clay loam or silty clay. The C horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 6. It commonly is silty clay loam or clay loam, but thin strata of silt loam or silty clay are in many pedons.

Milton Series

The Milton series consists of moderately deep, well drained, moderately permeable or moderately slowly permeable soils on ground moraines and end moraines. These soils formed in glacial till and in the underlying material weathered from limestone bedrock. Slope ranges from 1 to 4 percent.

Milton soils are commonly adjacent to the deep Glynwood, Milford, and Pewamo soils. Glynwood soils are in landscape positions similar to those of the Milton soils. Milford and Pewamo soils are on broad flats at the base of slopes.

Typical pedon of Milton silt loam, 1 to 4 percent slopes, in an area of Marion Township about 1.5 miles northwest of Marion; about 1,550 feet east and 1,800 feet south of the northwest corner of sec. 16, T. 5 S., R. 15 E.

Ap—0 to 12 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure parting to weak fine granular; friable; common fine roots; few coarse fragments; neutral; abrupt wavy boundary.

Bt1—12 to 20 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium and fine subangular blocky structure; firm; few fine roots; few faint brown (10YR 4/3) clay films on faces of peds; common faint brown (10YR 4/3) silt coatings on faces of peds; few distinct dark grayish brown (10YR 4/2) organic coatings in root channels; few coarse fragments; neutral; clear smooth boundary.

Bt2—20 to 24 inches; brown (10YR 4/3) clay; strong medium and fine subangular blocky structure; firm; few very fine roots; many distinct dark brown (7.5YR 4/4) clay films on faces of peds; few coarse fragments; neutral; clear smooth boundary.

2Bt3—24 to 29 inches; dark brown (7.5YR 4/2) clay; strong medium and fine subangular blocky structure; very firm; few very fine roots; common distinct dark brown (7.5YR 4/4) clay films on faces of peds; few coarse fragments; neutral; gradual smooth boundary.

2R—29 to 31 inches; hard limestone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The Ap horizon has hue of 10YR or 7.5YR and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is clay, silty clay loam, or clay loam. The 2Bt horizon has hue of 10YR or 7.5YR and chroma of 2 to 4.

Muskego Series

The Muskego series consists of deep, very poorly drained soils on ground moraines, end moraines, and lake plains. These soils formed in organic deposits derived from grasses, sedges, and reeds and are underlain by sedimentary peat (coprogenous earth). Permeability is moderate or moderately rapid in the organic deposits and slow in the sedimentary peat. Slope is 0 to 2 percent.

Muskego soils are commonly adjacent to the mineral Centerburg and Milford soils. Centerburg soils are moderately well drained and are on slight rises and low knolls. Milford soils are on broad flats, in depressions, and along drainageways.

Typical pedon of Muskego muck, in an area of Scott Township about 2.1 miles southwest of Kirkpatrick; about 1,980 feet east and 2,065 feet north of the southwest corner of sec. 28, T. 4 S., R. 16 E.

Oa1—0 to 16 inches; sapric material, black (N 2/0) broken face and rubbed, black (10YR 2/1) dry; about 5 percent fiber, a trace rubbed; weak fine and very fine granular structure; very friable; common fine and very fine roots; slightly acid; abrupt irregular boundary.

Oa2—16 to 24 inches; sapric material, dark reddish brown (5YR 2/2) broken face; about 15 percent fiber, 5 percent rubbed; massive; firm, nonsticky; few fine and very fine roots; slightly acid; clear wavy boundary.

C1—24 to 35 inches; very dark gray (10YR 3/1) coprogenous earth; about 15 percent fiber, 5 percent rubbed; massive; firm, nonsticky; few very fine roots; few coarse fragments; medium acid; clear wavy boundary.

C2—35 to 60 inches; dark grayish brown (2.5Y 4/2) coprogeneous earth; about 5 percent fiber, 2 percent rubbed; massive; slightly plastic; many small white (10YR 8/2) snail shells; strong effervescence; moderately alkaline.

The depth to coprogenous earth ranges from 16 to 51 inches. A few wood fragments, twigs, and branches, 1/8 inch to 2 inches in diameter, make up less than 5 percent of the volume in some pedons. The surface tier has hue of 5YR to 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. The C horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 to 3. It has few to many snail shells.

Newark Series

The Newark series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slope is 0 to 2 percent.

Newark soils are commonly adjacent to Nolin soils. Nolin soils are well drained and are in landscape positions similar to those of the Newark soils or are in the slightly higher positions.

Typical pedon of Newark silt loam, occasionally flooded, in an area of Claridon Township about 0.8 mile southeast of Caledonia; about 250 feet west and 990 feet south of the northeast corner of sec. 12, T. 5 S., R. 16 E.

A—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common medium and coarse roots; slightly acid; clear wavy boundary.

Bw—12 to 20 inches; brown (10YR 5/3) silt loam; many medium distinct yellowish brown (10YR 5/6) and many medium faint grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; common medium and coarse roots; few fine black (10YR 2/1) concretions (iron and manganese oxides); few distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; medium acid; clear wavy boundary.

Bg1—20 to 38 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/6) and common medium faint brown (10YR 5/3) and light brownish gray (10YR 6/2) mottles; moderate medium and fine subangular blocky structure; friable; common medium roots; few fine black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Bg2—38 to 44 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct gray (10YR 5/1) and dark yellowish brown (10YR 4/4) mottles; weak medium and fine subangular blocky structure; friable; common medium roots; few medium black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Cg—44 to 60 inches; gray (10YR 5/1) silt loam; common medium distinct yellowish brown (10YR 5/4) and few medium faint gray (10YR 6/1) mottles; massive; friable; neutral.

The thickness of the solum ranges from 36 to 44 inches. Most pedons do not have coarse fragments in the solum, but the content of these fragments is as much as 20 percent below a depth of 40 inches.

The B horizon has value of 4 or 5 and chroma generally of 2 to 4. In some pedons it has chroma of 1 in the lower part. It is silt loam or silty clay loam. The C

horizon has value of 4 or 5 and chroma of 1 to 4. It commonly is silt loam or silty clay loam but has thin strata of loam in some pedons.

Nolin Series

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

Nolin soils are commonly adjacent to Fox, Glynwood, and Newark soils. Fox soils have a higher content of sand and coarse fragments throughout than the Nolin soils. They are in the higher landscape positions. Glynwood soils have more clay in the subsoil than the Nolin soils. They are on side slopes in the uplands. Newark soils are somewhat poorly drained and are in the slightly lower landscape positions or are in positions similar to those of the Nolin soils.

Typical pedon of Nolin silt loam, occasionally flooded, in an area of Scott Township about 1.2 miles northeast of Caledonia; about 2,400 feet south and 1,400 feet west of the northeast corner of sec. 36, T. 4 S., R. 16 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; very friable; few medium roots; neutral; clear smooth boundary.

Bw1—8 to 11 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; few fine roots; slightly acid; clear wavy boundary.

Bw2—11 to 33 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and fine subangular blocky structure; firm; few very fine roots; medium acid; clear wavy boundary.

Bw3—33 to 40 inches; brown (10YR 4/3) silt loam; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few very fine roots; medium acid; gradual wavy boundary.

C—40 to 60 inches; yellowish brown (10YR 5/4) stratified silt loam and silty clay loam; common medium faint yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; medium acid.

The thickness of the solum ranges from 40 to 48 inches. The Ap horizon has chroma of 2 or 3. The B horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is stratified silt loam, silty clay loam, or loam.

Ockley Series

The Ockley series consists of deep, well drained soils that generally are on stream terraces but in a few areas are on the hummocky parts of moraines. These soils formed in loamy outwash and in the underlying calcareous, sandy and gravelly material. Permeability is moderate in the solum and very rapid in the underlying material. Slope ranges from 0 to 6 percent.

Ockley soils are similar to Martinsville soils and are commonly adjacent to Kendallville, Medway, and Sleeth soils. Kendallville soils are underlain by glacial till. They are on low knolls and side slopes. Martinsville soils have fewer coarse fragments in the subsoil and underlying material than the Ockley soils. Medway soils are moderately well drained and are on the lower stream terraces. Sleeth soils are somewhat poorly drained and are in the lower landscape positions and along drainageways.

Typical pedon of Ockley loam, 2 to 6 percent slopes, in an area of Waldo Township about 1.6 miles north of Waldo; about 1,810 feet west and 500 feet south of the northeast corner of sec. 36, T. 6 S., R. 15 E.

Ap—0 to 10 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; few very fine roots; few coarse fragments; medium acid; clear wavy boundary.

Bt1—10 to 26 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few very fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of peds; about 10 percent coarse fragments; medium acid; clear wavy boundary.

Bt2—26 to 40 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate coarse and medium subangular blocky structure; firm; few very fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of peds; about 15 percent coarse fragments; medium acid; clear wavy boundary.

Bt3—40 to 57 inches; dark brown (7.5YR 4/2) gravelly sandy clay loam; weak fine granular structure; friable; few very fine roots; few distinct dark brown (7.5YR 4/2) clay films on faces of peds; few distinct dark brown (7.5YR 3/2) organic stains on faces of peds; about 15 percent coarse fragments; slightly acid; abrupt wavy boundary.

BC—57 to 60 inches; yellowish brown (10YR 5/6) gravelly loam; massive; friable; thin strata of gravelly sandy loam; about 20 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

2C—60 to 70 inches; yellowish brown (10YR 5/4) very gravelly loamy sand; single grained; loose; about 40 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 55 to 72 inches. The content of coarse fragments ranges from 0 to 10 percent in the Ap horizon and in the upper part of the Bt horizon, from 2 to 30 percent in the lower part of the Bt horizon, and from 25 to 40 percent in the C horizon.

The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR and value of 4 or 5. It has chroma of 3 to 6 in the upper part and chroma of 2 or 3 in the lower part. It is clay loam, loam, sandy clay loam, or the gravelly analogs of these textures. The 2C horizon has value of 4 or 5 and chroma of 3 or 4.

Paulding Series

The Paulding series consists of deep, very poorly drained, very slowly permeable soils on lake plains. These soils formed in lacustrine sediments. Slope is 0 to 2 percent.

Paulding soils are similar to Latty soils and are commonly adjacent to Fulton, Latty, and Milford soils. Fulton soils are somewhat poorly drained soils and are on slight rises. Latty and Milford soils have less clay throughout than the Paulding soils. They are along the edges of areas of the Paulding soils.

Typical pedon of Paulding clay, in an area of Salt Rock Township about 4 miles north of Meeker; about 1,070 feet east and 330 feet south of the northwest corner of sec. 18, T. 4 S., R. 14 E.

Ap—0 to 8 inches; dark gray (10YR 4/1) clay, gray (10YR 6/1) dry; weak medium subangular blocky structure; firm; common very fine roots; neutral; abrupt wavy boundary.

Bg1—8 to 12 inches; dark gray (N 4/0) clay; common medium prominent olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; very firm; few very fine roots; neutral; clear smooth boundary.

Bg2—12 to 26 inches; dark gray (N 4/0) clay; common medium prominent olive brown (2.5Y 4/4) and few fine prominent light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to weak medium angular blocky; very firm; few very fine roots; neutral; gradual wavy boundary.

Bg3—26 to 47 inches; gray (N 5/0) clay; common medium prominent olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure parting to weak coarse angular blocky; very firm; few very fine roots; neutral; gradual wavy boundary.

BCg—47 to 53 inches; gray (N 5/0) clay; common medium prominent olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/6) mottles; weak very coarse prismatic structure; very firm; few very fine roots; slight effervescence; mildly alkaline; gradual wavy boundary.

Cg—53 to 60 inches; gray (5Y 5/1) clay; common medium prominent olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/6) mottles; massive; very firm; slight effervescence; mildly alkaline.

The solum is 50 to 55 inches thick. The Ap horizon has chroma of 1 or 2. The Bg horizon has hue of 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 4.

Pewamo Series

The Pewamo series consists of deep, very poorly drained, moderately slowly permeable soils on ground moraines and end moraines. These soils formed in moderately fine textured, calcareous glacial till. Slope is 0 to 2 percent.

Pewamo soils are commonly adjacent to Bennington, Blount, Elliott, and Glynwood soils. Bennington, Blount, and Elliott soils are somewhat poorly drained and are on slight rises. Glynwood soils are moderately well drained and are on low knolls and side slopes.

Typical pedon of Pewamo silty clay loam, in an area of Waldo Township about 2.5 miles northwest of Waldo; about 825 feet west and 990 feet south of the northeast corner of sec. 34, T. 6 S., R. 15 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium and fine subangular blocky structure; firm; common fine and very fine roots; few coarse fragments; neutral; abrupt smooth boundary.

Btg1—11 to 20 inches; gray (10YR 5/1) silty clay; common fine distinct dark yellowish brown (10YR 4/4) and common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium and fine subangular blocky structure; firm; common fine and very fine roots; few faint dark gray (10YR 4/1) clay films in pores and root channels; many prominent dark gray (10YR 4/1) organic coatings on faces of peds; few coarse fragments; few very dark gray (10YR 3/1) krotovinas; slightly acid; gradual wavy boundary.

Btg2—20 to 35 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; common fine and very fine roots; few faint gray (10YR 5/1) clay films in pores and root channels; few prominent dark gray (10YR 4/1) organic coatings on faces of peds; few coarse fragments; few very dark gray (10YR 3/1) krotovinas; neutral; clear irregular boundary.

BC—35 to 53 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; few fine and very fine roots; few coarse fragments; few very dark gray (10YR 3/1) krotovinas; neutral; gradual wavy boundary.

C—53 to 60 inches; brown (10YR 4/3) clay loam; common coarse distinct gray (10YR 5/1) mottles; massive; very firm; few coarse fragments; few fine

light gray (10YR 7/1) soft accumulations of calcium carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 67 inches. The thickness of the mollic epipedon ranges from 10 to 17 inches. The content of coarse fragments is 0 to 10 percent throughout the profile.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, silty clay loam, clay, or silty clay. The C horizon has value of 4 or 5 and chroma of 1 to 4. It is clay loam or silty clay loam.

Saranac Series

The Saranac series consists of deep, very poorly drained, moderately slowly permeable soils on flood plains. These soils formed in alluvium. Slope is 0 to 2 percent.

Saranac soils are similar to Sloan soils and are commonly adjacent to Del Rey and Milford soils. Del Rey soils are somewhat poorly drained and are on slight rises. Milford soils regularly decrease in content of organic matter with increasing depth. They are on slight rises along the edges of areas of the Saranac soils. Sloan soils have less clay in the subsoil than the Saranac soils.

Typical pedon of Saranac silty clay loam, occasionally flooded, in an area of Marion Township about 3.4 miles northwest of Marion; about 1,360 feet east and 495 feet north of the southwest corner of sec. 7, T. 5 S., R. 15 E.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; firm; few very fine roots; slightly acid; abrupt wavy boundary.

A—12 to 17 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium and fine subangular blocky structure; firm; few very fine roots; slightly acid; clear wavy boundary.

Bg1—17 to 30 inches; dark gray (10YR 4/1) silty clay; common medium distinct dark yellowish brown (10YR 4/4) and few fine distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very firm; few very fine roots; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; slightly acid; clear wavy boundary.

Bg2—30 to 35 inches; dark gray (10YR 4/1) silty clay loam; few fine prominent yellowish brown (10YR 5/6) and many medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium and fine subangular blocky structure; firm; neutral; gradual wavy boundary.

Cg—35 to 60 inches; gray (10YR 5/1) stratified silty clay loam and silty clay; many medium distinct yellowish brown (10YR 5/4) and few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; dark brown (7.5YR 4/4) iron stains; neutral.

The thickness of the solum ranges from 30 to 45 inches. The thickness of the mollic epipedon ranges from 10 to 17 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg and C horizons have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. They are silty clay, silty clay loam, or clay loam.

Shinrock Series

The Shinrock series consists of deep, moderately well drained, moderately slowly permeable soils on lake plains. These soils formed in stratified lacustrine sediments. Slope ranges from 2 to 12 percent.

Shinrock soils are similar to Cardington and Glynwood soils and are commonly adjacent to Del Rey and Milford soils. Cardington and Glynwood soils have coarse fragments throughout. Del Rey soils are somewhat poorly drained and are on slight rises. Milford soils are very poorly drained and are on broad flats, in depressions, and along drainageways.

Typical pedon of Shinrock silt loam, 2 to 6 percent slopes, in an area of Salt Rock Township about 1.7 miles northwest of Morral; about 1,240 feet east and 2,150 feet south of the northwest corner of sec. 15, T. 4 S., R. 14 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; common fine and very fine roots; medium acid; abrupt smooth boundary.

Bt1—9 to 12 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint yellowish brown (10YR 5/6) and few medium distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; few fine and very fine roots; few faint dark yellowish brown (10YR 4/4) clay films on faces of peds; common distinct dark yellowish brown (10YR 4/4) silt coatings on faces of peds; strongly acid; clear wavy boundary.

Bt2—12 to 25 inches; yellowish brown (10YR 5/4) silty clay; common medium faint yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse angular blocky structure; firm; few fine roots; few faint brown (10YR 5/3) clay films on faces of peds; common distinct grayish brown (10YR 5/2) silt coatings on faces of peds; few fine black (N 2/0) concretions (iron and manganese oxides); strongly acid; gradual wavy boundary.

Bt3—25 to 37 inches; olive brown (2.5Y 4/4) silty clay; common medium distinct grayish brown (2.5Y 5/2) mottles; moderate coarse subangular blocky structure; firm; few fine roots; few faint brown (10YR

5/3) clay films on faces of peds; common distinct gray (10YR 5/1) silt coatings on faces of peds; few fine black (N 2/0) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

C—37 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; common medium faint light olive brown (2.5Y 5/6) mottles; massive; firm; common distinct grayish brown (2.5Y 5/2) silt coatings in vertical partings; common medium white (2.5Y 8/2) calcium carbonate nodules; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to carbonates ranges from 20 to 38 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam or silty clay. Some pedons have a BC horizon. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It commonly is silt loam or silty clay loam, but it has thin strata of silty clay or silt in some pedons.

Sleeth Series

The Sleeth series consists of deep, somewhat poorly drained soils on stream terraces. These soils formed in loamy outwash and in the underlying calcareous, sandy and gravelly outwash. Permeability is moderate in the solum and very rapid in the underlying material. Slope ranges from 0 to 3 percent.

Sleeth soils are similar to Whitaker soils and are commonly adjacent to Nolin, Ockley, Sloan, and Westland soils. Nolin and Ockley soils are well drained, and Sloan and Westland soils are very poorly drained. Nolin and Sloan soils are on flood plains. Ockley soils are in the slightly higher landscape positions. Westland soils are on broad flats, in depressions, and along drainageways. Whitaker soils have fewer coarse fragments in the subsoil and underlying material than the Sleeth soils.

Typical pedon of Sleeth loam, 0 to 3 percent slopes, in an area of Grand Prairie Township about 3.5 miles east of Morral; about 1,500 feet east and 1,300 feet north of the southwest corner of sec. 16, T. 4 S., R. 15 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to moderate fine granular; friable; few very fine roots; slightly acid; abrupt smooth boundary.

Bt1—11 to 15 inches; brown (10YR 5/3) clay loam; common medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; firm; few very fine roots; many grayish brown (10YR 5/2) coatings on faces of peds; few faint grayish brown (10YR 5/2) clay films on faces of peds; dark grayish brown (10YR 4/2) organic coatings in root channels; few coarse fragments; strongly acid; clear smooth boundary.

Bt2—15 to 24 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few very fine roots; few faint grayish brown (10YR 5/2) clay films on faces of peds; many faint grayish brown (10YR 5/2) coatings on faces of peds; few coarse fragments; strongly acid; clear smooth boundary.

Bt3—24 to 30 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct gray (10YR 5/1) and few fine faint brown (7.5YR 5/4) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few faint dark grayish brown (10YR 4/2) clay films bridging sand grains; many distinct dark grayish brown (10YR 4/2) coatings on faces of peds; few coarse fragments; medium acid; clear wavy boundary.

Btg—30 to 41 inches; grayish brown (10YR 5/2) sandy clay loam; common medium prominent yellowish brown (10YR 5/6) and few medium distinct pale brown (10YR 6/3) mottles; weak coarse subangular blocky structure; firm; few faint dark grayish brown (10YR 4/2) clay films bridging sand grains; about 10 percent coarse fragments; medium acid; abrupt smooth boundary.

BCg—41 to 60 inches; dark gray (10YR 4/1) gravelly sandy loam; common fine prominent yellowish brown (10YR 5/6) and common fine distinct brown (10YR 5/3) mottles; weak coarse subangular blocky structure; very friable; thin strata of grayish brown (10YR 5/2) loam and sand; about 15 percent coarse fragments; neutral; gradual wavy boundary.

2Cg—60 to 80 inches; dark gray (10YR 4/1) stratified sand and very gravelly sand; single grained; loose; about 40 percent coarse fragments; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges from 2 to 20 percent in the B horizon and from 15 to 40 percent in the 2C horizon.

The Ap horizon has chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 2 to 4. It is clay loam, sandy clay loam, loam, or the gravelly analogs of these textures. The 2C horizon has value of 4 or 5 and chroma of 1 or 2. It is stratified sand, loamy coarse sand, or the gravelly or very gravelly analogs of these textures.

Sloan Series

The Sloan series consists of deep, very poorly drained, moderately permeable or moderately slowly

permeable soils on flood plains. These soils formed in silty and loamy alluvium. Slope is 0 to 2 percent.

Sloan soils are similar to Saranac soils and are commonly adjacent to Blount and Glynwood soils. The somewhat poorly drained Blount and moderately well drained Glynwood soils are on uplands. Saranac soils have more clay in the subsoil than the Sloan soils.

Typical pedon of Sloan silty clay loam, occasionally flooded, in an area of Green Camp Township about 1.5 miles northeast of Green Camp; about 2,150 feet north and 80 feet west of the southeast corner of sec. 1, T. 6 S., R. 14 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few fine and very fine roots; slightly acid; abrupt smooth boundary.

A—8 to 11 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine and very fine granular structure; firm; common medium black (N 2/0) concretions (iron and manganese oxides); few fine and very fine roots; slightly acid; abrupt wavy boundary.

Bg1—11 to 20 inches; dark gray (10YR 4/1) silt loam; common medium faint dark brown (7.5YR 4/2) mottles; weak fine and very fine granular structure; friable; common medium black (N 2/0) concretions (iron and manganese oxides); common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; few fine and very fine roots; neutral; clear wavy boundary.

Bg2—20 to 37 inches; dark gray (10YR 4/1) clay loam; common medium distinct dark yellowish brown (10YR 4/4), common medium prominent yellowish brown (10YR 5/6), and common medium faint dark brown (7.5YR 4/2) mottles; weak medium and fine subangular blocky structure; firm; common medium black (N 2/0) concretions (iron and manganese oxides); common faint very dark gray (10YR 3/1) coatings on faces of peds; few fine and very fine roots; neutral; clear wavy boundary.

Bg3—37 to 47 inches; gray (10YR 5/1) clay loam; common medium distinct dark yellowish brown (10YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; firm; common medium black (N 2/0) concretions (iron and manganese oxides); common faint gray (10YR 5/1) coatings on faces of peds; few fine and very fine roots; neutral; gradual wavy boundary.

C—47 to 60 inches; strong brown (7.5YR 5/6) silty clay loam; common medium prominent gray (10YR 5/1) mottles; massive; firm; gray (10YR 5/1) clay seams; neutral.

The solum is 41 to 47 inches thick. The thickness of the mollic epipedon ranges from 10 to 23 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay loam, clay loam, or silt loam. The C horizon has hue of 10YR or 7.5YR and chroma of 1 to 6. It commonly is loam, silty clay loam, or clay loam. It is stratified in some pedons.

Westland Series

The Westland series consists of deep, very poorly drained soils on stream terraces. These soils formed in loamy outwash and in the underlying calcareous, sandy and gravelly outwash. Permeability is moderate in the solum and very rapid in the underlying material. Slope is 0 to 2 percent.

Westland soils are commonly adjacent to Fox, Sleeth, and Sloan soils. Fox soils are well drained and are on slight rises along the edges of areas of the Westland soils. Sleeth soils are somewhat poorly drained and are on slight rises. Sloan soils have fewer coarse fragments throughout than the Westland soils. They are on flood plains.

Typical pedon of Westland clay loam, in an area of Grand Prairie Township about 0.8 mile east of Brush Ridge; about 2,600 feet east and 900 feet north of the southwest corner of sec. 16, T. 4 S., R. 15 E.

Ap—0 to 12 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; friable; few roots; few coarse fragments; neutral; clear smooth boundary.

Btg1—12 to 15 inches; dark gray (N 4/0) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; very dark gray (10YR 3/1) organic coatings on faces of peds; few faint dark gray (10YR 4/1) clay films on faces of peds; few coarse fragments; neutral; abrupt smooth boundary.

Btg2—15 to 25 inches; gray (10YR 5/1) clay loam; common medium prominent yellowish brown (10YR 5/6) and few fine faint dark gray (10YR 4/1) mottles; weak coarse and medium subangular blocky structure; firm; few faint gray (10YR 5/1) clay films on faces of peds; about 5 percent coarse fragments; neutral; abrupt smooth boundary.

Btg3—25 to 35 inches; dark gray (10YR 4/1) clay loam; many fine prominent yellowish brown (10YR 5/6) and common medium faint gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; few faint gray (10YR 5/1) clay films on faces of peds; strata of sandy clay loam in the lower part; about 10 percent coarse fragments; neutral; abrupt smooth boundary.

BCg—35 to 43 inches; dark gray (10YR 4/1) stratified gravelly sandy loam and sandy clay loam; weak coarse subangular blocky structure; friable; about 15 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg—43 to 60 inches; dark gray (10YR 4/1) very gravelly loamy coarse sand; single grained; loose; about 40 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 58 inches. The mollic epipedon is 10 to 15 inches thick. The content of coarse fragments ranges from 2 to 15 percent in the solum and from 15 to 50 percent in the 2C horizon.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It is dominantly clay loam in the upper part and clay loam, sandy loam, or sandy clay loam in the lower part. In many pedons, however, it has subhorizons of silty clay loam. The 2C horizon has value of 4 or 5 and chroma of 1 or 2. It is the gravelly or very gravelly analogs of coarse sand or loamy coarse sand.

Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, moderately permeable soils that generally are on stream terraces and along the shoreline of former glacial lakes but in a few areas are on ground moraines. These soils formed in loamy outwash or lacustrine sediments. Slope ranges from 0 to 3 percent.

Whitaker soils are similar to Fitchville and Sleeth soils and are commonly adjacent to Milford and Nolin soils. Fitchville soils have more silt throughout than the Whitaker soils. Milford soils are very poorly drained and are on broad flats, in depressions, and along drainageways. Nolin soils are well drained and are on flood plains. Sleeth soils have a higher content of coarse fragments in the subsoil and underlying material than the Whitaker soils.

Typical pedon of Whitaker loam, 0 to 3 percent slopes, in an area of Grand Prairie Township about 2.3 miles south-southwest of Brush Ridge; about 1,730 feet south and 700 feet east of the northwest corner of sec. 32, T. 4 S., R. 15 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; common fine and very fine roots; medium acid; abrupt wavy boundary.

BE—10 to 14 inches; brown (10YR 5/3) loam; few medium faint light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and very fine roots; common faint grayish brown (10YR 5/2) silt coatings on faces of peds; very few faint brown (10YR 4/3) clay films in pores; few distinct dark grayish brown (10YR 4/2) organic coatings in root channels; few fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Bt1—14 to 26 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few very fine roots; many distinct grayish brown (10YR 5/2) silt coatings on faces of peds; few faint grayish brown (10YR 5/2) clay films on faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

Bt2—26 to 34 inches; yellowish brown (10YR 5/6) clay loam; many medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few distinct light brownish gray (2.5Y 6/2) clay films in pores and root channels; many distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); strongly acid; clear wavy boundary.

BCg1—34 to 41 inches; light brownish gray (2.5Y 6/2) loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; few very fine roots; few medium black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

BCg2—41 to 60 inches; grayish brown (10YR 5/2) sandy loam; common medium prominent light olive brown (2.5Y 5/6) mottles; weak coarse subangular blocky structure; friable; few medium black (10YR 2/1) concretions (iron and manganese oxides); medium acid.

The thickness of the solum ranges from 40 to 60 inches. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is dominantly clay loam or sandy clay loam. In some pedons, however, it has strata of silt loam, silty clay loam, or loam. The BC horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is loam, silt loam, sandy loam, or sandy clay loam.

Formation of the Soils

This section relates the factors of soil formation to the soils in Marion County. It also describes the processes of soil formation.

Factors of Soil Formation

The major factors of soil formation are parent material, climate, relief, living organisms, and time (*8*). Climate and living organisms, particularly vegetation, are the active forces of soil formation. Their effects on the parent material are modified by relief and time. The importance of each factor differs from place to place. Differences among soils are caused by variations in one or more of these factors.

Parent Material

Parent material largely determines the texture of the soils. Most of the soils in Marion County formed in glacial till. Others formed in lacustrine deposits, glacial outwash, alluvium, material weathered from limestone bedrock, and organic deposits.

Glacial till is material that was deposited directly by glacial ice. The composition of this material varies throughout the county. The till generally is unstratified, compact silty clay loam or clay loam. It has rock fragments in varying proportions and sizes and has a moderate to high content of lime. It ranges from a few inches to more than 100 feet in thickness. Soils that formed in glacial till are generally compact, have a moderately fine textured or fine textured subsoil, and are slowly permeable or moderately slowly permeable. Bennington, Blount, Glynwood, and Pewamo soils are examples.

The glacial till in some parts of the county has been slightly modified by water action. As a result, the upper part of the soils in these areas is more friable and slightly more loamy than the unmodified till. These areas are adjacent to streams and postglacial lakes and in areas on till plains where the downwasting and stagnation of glacial ice caused the formation of shallow lakes.

Lacustrine deposits are clastic sediments deposited on the bottom of postglacial lakes. These sediments are stratified or laminated, are silty or clayey, and have no coarse fragments. They generally are high in content of lime. They range from several feet to more than 20 feet in thickness. Soils that formed in lacustrine sediments generally have a moderately fine textured or fine textured subsoil and are moderately slowly permeable or slowly permeable. Del Rey, Milford, Latty, and Shinrock soils are examples.

Glacial outwash was deposited by glacial meltwater moving down the valleys. These deposits are silty, loamy, sandy, and gravelly. Soils that formed in outwash are generally loose, are highly stratified, and are moderately permeable to very rapidly permeable. Examples are Fox and Westland soils, which have a fine-loamy, moderately permeable subsoil and rapidly permeable or very rapidly permeable underlying material. These soils are good sources of sand and gravel.

Alluvium was deposited by floodwater. It is the youngest parent material in the county. It is still accumulating as fresh sediment added by overflowing streams. The source of most alluvium is erosion on other soils farther upstream in the watershed. Alluvial material is highly stratified and is silty or loamy. Soils that formed in alluvium commonly have a silty or loamy subsoil and are medium to high in natural fertility. Newark, Nolin, and Sloan soils are examples.

Material weathered from limestone bedrock is the parent material of the lower part of the subsoil in Milton soils. The limestone was deposited during a period when the survey area was covered by shallow seas. Most of the bedrock has since been covered by other parent materials. Weathering of the upper part of the limestone commonly results in the formation of sticky, clayey material in the lower part of the subsoil, near the point of contact with the rock.

Organic material has accumulated in a few scattered depressions and drainageways in the county. It consists mainly of the decomposed remains of trees, sedges, and grasses in areas where the water table is high and where seepage keeps the soils permanently wet. Muskego soils formed in this material. They are characterized by a very high content of organic matter, very poor drainage, and low strength.

Climate

The soils in Marion County formed under a humid, temperate continental climate. Climatic factors, such as precipitation, temperature, and evapotranspiration, strongly affect biotic communities and help to determine the kind of soils that form in large regions. The climate is fairly uniform throughout the county. Differences among

the soils within the county are not the result of climatic variations.

Climate affects the weathering and decomposition of minerals and the removal of material through leaching. Soluble bases are removed when they are released through the decomposition of mineral material. Percolating water translocates clay and sesquioxides from the surface layer to the lower horizons.

Relief

Relief influences soil formation through its effect on water movement, erosion, soil temperature, and the plant cover. It either directly or indirectly affects runoff, ponding, depth to the water table, internal drainage, and the accumulation and removal of organic matter.

Relief can account for the formation of different soils from the same kind of parent material. Examples are the nearly level to moderately steep, moderately well drained Glynwood soils, the nearly level and gently sloping, somewhat poorly drained Blount soils, and the nearly level, very poorly drained Pewamo soils, all of which formed in Wisconsin glacial till.

Water that runs off the more sloping soils collects in depressions or is removed through waterways. Therefore, from an equal amount of rainfall, the more sloping soils receive less water and depressional soils receive more water than the nearly level soils. This difference in water distribution and movement has important effects on soil formation.

Living Organisms

The vegetation under which a soil forms influences the color, structure, and organic matter content of the soil. Blount, Glynwood, and other soils that formed under forest vegetation generally are lighter in color and have a lower content of organic matter in the surface layer than soils that formed under grasses. The accumulation of organic matter results in a dark surface layer in some low lying soils, such as Elliott, Milford, and Pewamo.

The soils in Marion County formed under a variety of vegetative habitats, including mixed hardwood forests, grassland prairies, swamps, and marshes. Each of these habitats supported a characteristic vegetation, which influenced soil formation.

Bacteria, fungi, and many other micro-organisms aid in the breakdown of plant residue and in the return of this residue to the soil. The kind of organic residue that is returned to the soil depends, to some extent, on the kind of organisms involved in the breakdown. Generally, fungi are most active in acid soils and bacteria are most active in neutral or alkaline soils.

Earthworms, burrowing insects, and other small animals mix the soil. Their burrows help to make the soil porous and permit the percolation of water. Earthworms help to incorporate organic matter into the soil. In an area that is well populated with earthworms, the leaf litter that accumulates on the surface during autumn is usually incorporated into the soil by the following spring.

Time

The length of time that the parent material has been exposed to the processes of soil formation can have important effects on the soil. The distinctness of horizons indicates the maturity of the soil. Generally, the longer that climate and living organisms have acted upon the parent material, the more distinct the horizons in the profile. Bennington and Blount are examples of soils that have a strongly expressed profile.

Most of the parent materials in the county have been in place for about the same length of time. An exception is recent alluvium on flood plains. Nolin, Sloan, and other soils that formed in this alluvium are the youngest soils in the county. They have not been in place long enough to be significantly affected by the processes of soil formation.

In terms of geologic age, the soils in Marion County have been forming for a relatively short period. As a result, many of the soils are leached to a limited depth and have a medium acid to neutral subsoil.

Processes of Soil Formation

Soils form through complex, interrelated, continuing processes that are grouped into four general categories—additions, removals, transfers, and transformations (*12*). These four processes affect the formation of all soils, although their predominance varies.

One of the main types of addition is the accumulation of organic matter in the surface layer. This organic matter, which is derived from plants that grew in the soil, is mainly responsible for the darkness of the surface layer. It has darkened the surface layer of Elliott and Pewamo soils. Another type of addition occurs through the deposition resulting from erosion. Soils on flood plains, such as Nolin and Sloan soils, periodically receive soil material deposited by floodwater.

Removals that occur in soils include the leaching of bases, the removal of plant nutrients by crops, and the loss of soil through erosion. One of the main losses that has taken place in the soils of Marion County is the leaching of carbonates. Many of the soils in the county have been leached to a depth of 2 to 4 feet. The parent material was medium or high in content of calcium carbonates, but percolating water has leached the carbonates from the upper part of the profile.

The main kind of transfer in the soils in Marion County is the translocation of colloidal material from one horizon to another. In many of the soils, clay has been transferred from the A horizon to the B horizon. The result is the formation of a Bt horizon, which is a zone of illuviation, or gain. In Glynwood, Blount, and other soils, the B horizon contains more clay than the parent material or the A horizon. The B horizon in some soils

has thin clay films in pores and on the faces of peds. This clay has been transferred from the A horizon. The presence or absence of these clay films is an important criterion in soil classification.

Mineral compounds have undergone transformation in most of the soils in the county. Gleying, or the reduction and solution of ferrous iron, has taken place in the very poorly drained to somewhat poorly drained soils, such as Latty, Milford, and Paulding. This process is caused by a recurring high water table. Another type of transformation is the chemical weathering of primary silicate minerals into secondary minerals, mainly those of the layer-lattice silicate clays. The results of this process are most apparent if the formation of horizons has not been affected by rapid erosion or by the accumulation of material at the surface.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

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

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

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.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

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 that does not invert the soil and that 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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

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.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. The depth of the soil over bedrock. Deep soils are more than 40 inches deep over bedrock; moderately deep soils, 20 to 40 inches; and shallow soils, 10 to 20 inches.

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 is not a source of gravel or sand for construction purposes.

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.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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 meltwater.

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 meltwater. 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 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

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.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

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 uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

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, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon 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) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 overlying 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, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain. A broad plain that was once the bottom of a lake. The lake water either evaporated or has been drained.

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.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

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. Coarse sandy loam, 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 end, 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.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

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.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

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.

Perimeter drain. A drain installed around the perimeter of a septic tank absorption field. The drain lowers the water table. Also called curtain drain.

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 0.2 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.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

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.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts 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.

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.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

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.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 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 millimeters 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, E, 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.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

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 soil blowing 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. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It 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.

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.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water bar. A shallow trench and a mound of earth constructed at an angle across a road or trail to intercept and divert surface runoff and control erosion.

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.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.