United States
Department of
Agriculture

Soil
Conservation
Service

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

Soil Survey of Huron County, Ohio

How To Use This Soil Survey

General Soil Map

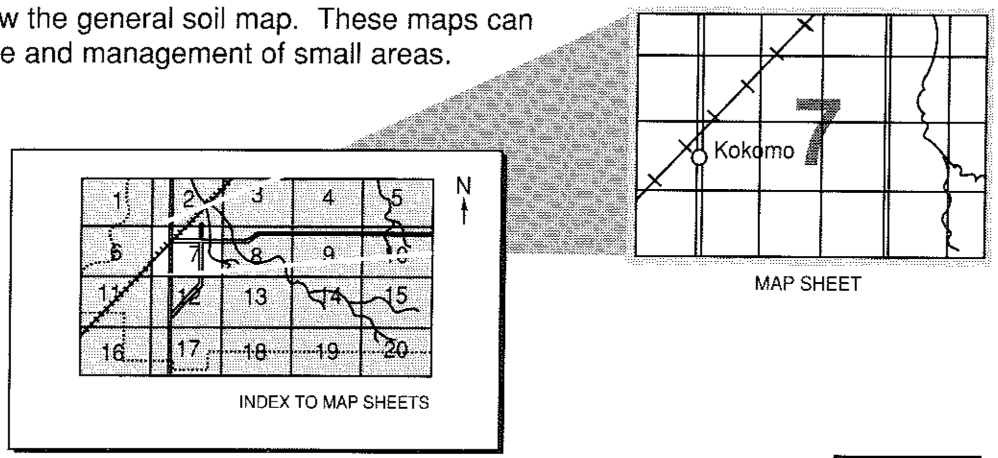
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

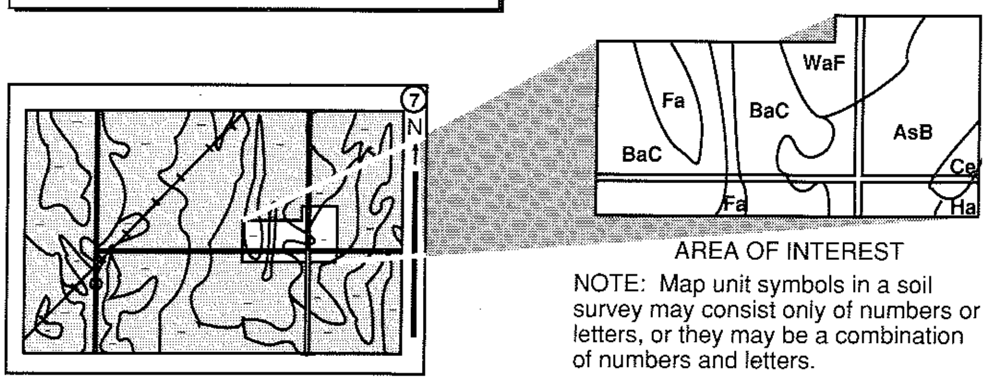
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

MAP SHEET

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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.

Major fieldwork for this soil survey was completed in 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Soil Conservation Service; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; the Ohio Agricultural Research and Development Center; and the Ohio Cooperative Extension Service. The preparation of this survey was materially aided by funds provided by the Huron County Commissioners. The survey is part of the technical assistance furnished to the Huron Soil and Water Conservation District.

Cover: Cropland in an area of Kibbie loam, 0 to 2 percent slopes. Much of the acreage in the county is used for crops, mainly corn and soybeans.

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Issued June 1994

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Foreword

This soil survey contains information that can be used in land-planning programs in Huron 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 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.

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Soil Survey of Huron County, Ohio

By J.E. Ernst and N.H. Martin, 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;
Ohio Agricultural Research and Development Center; and Ohio Cooperative Extension Service

HURON COUNTY is in the north-central part of Ohio (fig. 1). It has a total area of 317,517 acres, or about 496 square miles. Norwalk is the county seat. In 1980, the population of the county was 54,608 *(22)*.

This survey updates the survey of Huron County published in 1955 *(18)*. It provides additional data and soil interpretations and has larger maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about Huron County. It describes early settlement; agriculture; geology, physiography, relief, and drainage; ground water; and climate.

Early Settlement

Huron County, which is part of the Western Reserve, was organized as a separate county in 1815. The U.S. Government granted half a million acres in the Western Reserve to compensate those who were burned out by British troops during the American Revolution. The area became known as the "Fire Sufferer's Land," which was later shortened to the "Firelands." The settlers who were granted this land came from Connecticut. They fled from New Haven, New London, Ridgefield, Fairfield, Greenwich, and Norwalk, and they later named their new towns after those towns.

Nearly all of Huron County was forested at the time of settlement *(9)*. An area of prairie vegetation that was described by the early settlers as treeless, however, extended from Bellevue to Monroeville and then northward.

Agriculture

Gary W. Bauer, county extension agent, Cooperative Extension Service, helped prepare this section.

Most of the early settlers in the county made their living from agriculture, chiefly from growing corn. Other grains, such as oats, rye, buckwheat, and barley, also were grown. Pioneer families generally raised a few animals for their own use. After clearing the land of native trees for agriculture, the early farmers commonly planted fruit trees. Apples, peaches, pears, cherries, and other fruits were introduced by the settlers. The rich, dark soils were quite productive. A system of drainage ditches was established by the early farmers. It has been improved and maintained by successive generations.

Most of the land in the county currently is used for agricultural purposes, including cash grain crops, specialty crops, and dairy and livestock enterprises. The main trend in the county is toward fewer dairy and livestock farms and more cash grain farming. Corn, soybeans, wheat, and hay are the main crops. Specialty crops, such as tomatoes, cabbage, sugar beets, and other vegetables, are grown on a small acreage on the lake plains and beach ridges.

Huron County is one of the top counties in Ohio in terms of total farm income. It ranks first in Ohio in the sale of fresh market vegetable crops. The mucky soils in the Willard Marsh, in the vicinity of Celeryville, and many of the sandy and loamy soils near Norwalk are

Figure 1.—Location of Huron County in Ohio.

used for these crops. Willard Marsh is known as the "Salad Bowl" of Ohio (fig. 2).

The farm income in the county is derived from the sale of livestock, corn, wheat, soybeans, oats, hay, and vegetables *(11)*. Fruit and vegetables account for about 26 percent of the total income; soybeans, 24 percent; corn, 21 percent; dairy products, 14 percent; hogs, 5 percent; cattle, 5 percent; wheat, 4 percent; and hay, 1 percent.

About 80 percent of the land area in the county is in farms. In 1986, the county had 1,060 farms, which averaged 235 acres in size *(5)*. A total of 61,000 acres was used for corn, 84,000 acres for soybeans, 20,000 acres for wheat, 4,300 acres for oats, 9,700 acres for hay, and 4,500 acres for vegetables. The county had a total of about 12,000 cattle, 15,000 hogs, and 4,000 sheep in 1986.

Most of the soils in the county are highly productive if drainage systems, erosion-control measures, and other appropriate management practices are applied. Poor natural drainage is the main limitation in the less sloping parts of the county. Erosion is a hazard in the gently sloping to very steep areas. Each year, more farmers are applying conservation tillage methods, such as no-till farming, to control erosion.

Geology, Physiography, Relief, and Drainage

Huron County is in the Central Lowland Physiographic Province *(6)*, which includes most of the glaciated parts of Ohio. The county is mainly on till plains, but a small part in the northwest corner is on lake plains.

Several glaciers formerly covered the county. The last one was the Late Wisconsinan Glacier, which covered the county 10,000 to 15,000 years ago. Late Wisconsinan drift covered all of the material deposited by the previous glaciers *(16)*. The mantle of glacial drift ranges from less than 2 to more than 150 feet in thickness. The drift is underlain by limestone in the extreme northwest corner of the county and by shale or sandstone throughout the rest of the county. The limestone consists of the Columbus and Delaware Formations of Devonian age. The western third of the county is underlain by the Olentangy and Ohio Shales of Devonian age. The rest of the county is underlain by shale and sandstone of the Waverly Formation of Mississippian age.

Most of the till plains are nearly level to gently rolling, but some areas along streams are steeper. When the glacial ice melted more rapidly than its forward movement, the load of unsorted material carried by the glacier was deposited over the basal till as a fairly level layer known as a ground moraine. The northeastern part of the county, which includes Townsend, Wakeman, Hartland, and Clarksfield Townships, is an example of a ground moraine. Bennington, Cardington, and Condit are the major soils on the ground moraines in the county.

The till plains in the southern part of the county are divided by the Defiance and Fort Wayne End Moraines *(8)*. These moraines were deposited while the ice front remained relatively stationery because the rate at which the ice melted roughly equaled or slightly exceeded the rate of forward movement during the recessional stages of the glacier.

The Defiance End Moraine is a terminal moraine that crosses the entire State of Ohio. It occurs in the western part of Huron County, including the northern part of Richmond Township and the southern part of Norwich Township, and extends eastward through the county. The Fort Wayne End Moraine is along the southern edge of the county, in New Haven, Ripley, and Greenwich Townships. Bennington and Cardington are the major soils on these end moraines. The end moraines in the county commonly have more pronounced, more complex relief than the ground

Figure 2.—An area of Carlisle, Linwood, and Colwood soils in the Willard Marsh. These soils are used mainly for vegetable crops.

moraines and are more severely eroded.

Associated with the stagnant or recessional stage of the leading ice front are small areas of an end moraine that was formed when the ice sheet deposited huge masses of ice surrounded by a mixture of ice and glacial debris. The melting of the ice resulted in rounded hills, called kames. Kames are in Bronson, Fairfield, Greenfield, and Fitchville Townships. Chili soils are on the kames.

As the glacier melted and receded northward, glacial lakes commonly formed in front of the ice sheet. Depending on the rate at which water flowed from the melting ice, sediment was deposited as coarse grained outwash deposits, both well sorted and poorly sorted, and as fine grained lacustrine sediment, both thinly bedded and thickly bedded. The relief of the lake plains is more subtle than that of the till plains. The lake plains start at a point south of Bellevue, in Lyme Township, continue southeast through Ridgefield Township, and extend east into Norwalk Township. Kibbie, Pewamo, and Tuscola are the dominant soils on the lake plains. Prominent sandy or gravelly beach ridges formed by wave action were left on the margins of the glacial lakes *(7)*. Examples are the ridges along U.S. Route 20; State Route 61, north of Norwalk; and Sand Hill Road. Chili, Oshtemo, Otisville, and Spinks are the major soils on the beach ridges and in the areas of coarse grained outwash.

The southwestern part of the county has a glacial lake basin known as the Willard Marsh. Lacustrine sediment and glacial outwash were deposited in the basin, and layers of organic matter accumulated on the

Figure 3.—A steep escarpment of shale bedrock along the West Branch of the Huron River. Brecksville soils formed in residuum of this bedrock formation.

floor of the lake. This basin is in the southeastern part of Richmond Township and the southwestern part of New Haven Township. Carlisle, Colwood, and Lenawee are the dominant soils in this basin.

Surface water in Huron County drains northward into Lake Erie. The eastern part of the county is drained by the Vermilion River and its tributaries. The central and western parts are drained by several tributaries of the Huron River. In areas where streams eroded through the glacial drift and into the underlying rock formations, steep bluffs and narrow valleys formed (fig. 3). The extreme southwest corner of the county is drained by Honey Creek, which flows westward into the Sandusky River.

Ground Water

The depth to ground water and the quality and quantity of the water vary considerably in Huron County. Both the glacial deposits and the underlying bedrock can be water-bearing materials.

The glacial deposits range from less than 2 to more than 150 feet in thickness. Available water supplies occur as reservoirs in coarse grained lenses and stratified layers of sand and gravel. Yields as high as about 400 gallons per minute can be obtained in a few areas where there are layers of sand and gravel *(10)*. In most areas of the county, however, wells in the finer grained glacial deposits yield less than 10 gallons per minute.

Of the wells in the underlying bedrock, those in the cavernous limestone and dolomite in the extreme northwest corner of the county provide some of the highest yields. Yields of 100 to 400 gallons per minute can be obtained in this area. Most areas in the county are underlain by shale or sandstone and shale formations that generally yield less than 10 gallons per minute. The water from the wells in these areas may have relatively high levels of hardness, iron, and sulfates.

In areas where the supply of ground water is inadequate, shallow wells, cisterns, and ponds provide additional water for the homes and farms in the county.

Climate

Huron County is cold in winter and quite hot in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture by spring. This accumulation minimizes droughtiness in most of the soils during summer. The normal annual precipitation is adequate for all of the crops that are adapted to the temperature and growing season in the county.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Norwalk, Ohio, during the period 1951 to 1984. Table 2 shows the probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the 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 Norwalk on April 5, 1963, is -25 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on June 26, 1952, is 102 degrees.

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

Of the total annual precipitation, nearly 22 inches, or about 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 19 inches. The heaviest 1-day rainfall during the period of record was 9.20 inches at Norwalk on July 5, 1969. Thunderstorms occur on about 36 days each year. Tornadoes and severe thunderstorms occur occasionally. These storms are usually local in extent and of short duration and cause damage in scattered areas.

The average seasonal snowfall is about 30 inches. The greatest snow depth at any one time during the period of record was 30 inches. On the average, 23 days 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 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

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 biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and 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, soil scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientists to predict with a considerable degree of 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 and record 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, reaction, 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 interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are 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 are 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 predict with a fairly high degree of accuracy 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 two or three 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 most common inclusions of contrasting soils are identified 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.

Survey Procedures

The general procedures followed in making the survey are described in the "National Soils Handbook" of the Soil Conservation Service. The survey of Huron

County published in 1955 *(18)*, a geology map of Ohio *(4)*, and a study of the beach ridges in northern Ohio *(7)* were among the references used. The maps and soil descriptions in the 1955 survey were used as a reference when the map units were designed and the soil transects were planned *(13)*.

Before fieldwork began, aerial photographs that were taken in October 1982 at a scale of 1:15,840 were studied. United States Geological Survey topographic maps at a scale of 1:24,000 were studied to relate land and image features. Reconnaissance was then made by vehicle before the soil scientists traversed the landscape on foot.

Some areas required remapping, particularly those on lake plains, outwash plains, beach ridges, and kames, where the soils were mapped in the old survey as series that are no longer used in Ohio. In these areas traverses were made at intervals of about one-quarter mile. Traverses at closer intervals were made in complex areas of high variability *(14)*. Some of these complex areas are in the Pewamo-Fries-Bennington, Colwood-Lenawee-Linwood, and Chili-Oshtemo-Haskins associations, which are described under the heading "General Soil Map Units."

In the areas on till plains, where most of the series from the old survey are still valid in Ohio, the traverses were made at intervals much wider than is customary in original mapping. In these areas adjustments of some slope lines were made because the slope ranges in the old survey were too wide for modern uses. Some areas of the more uniform till plains are in the Blount-Pandora-Glynwood and Bennington-Cardington-Condit associations.

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.

Some of the soil boundaries and soil names on the general soil map of this county do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts and the application of the latest soil classification standards.

Deep and Moderately Deep Soils on Upland Till Plains and Lake Plains

These soils make up about 88 percent of the county. They are nearly level to sloping and are very poorly drained to moderately well drained. They formed in glacial till, lacustrine sediment, and alluvial sediment. The landscape is characterized by broad flats and depressions that have slight rises and by gentle slopes. The soils are used mainly as cropland. Wetness, ponding, the hazard of erosion, moderately slow or slow permeability, and a high shrink-swell potential are the main management concerns.

1. Blount-Pandora-Glynwood Association

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

This association is on ground and end moraines on till plains. The landscape is characterized by gently undulating flats that are dissected mainly by small, low-gradient streams and drainageways. Slope is 0 to 6 percent.

This association makes up about 2 percent of the county. It is about 55 percent Blount soils, 10 percent Pandora soils, 10 percent Glynwood soils, and 25 percent soils of minor extent.

The nearly level and gently sloping, somewhat poorly drained Blount soils are on broad flats and slight rises and in areas that are slightly dissected by small drainageways. The surface layer is silt loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is moderately slow or slow.

The nearly level, poorly drained Pandora soils are in depressions and along drainageways. The surface layer is silty clay loam. The content of organic matter is moderate. A seasonal high water table is near or above the surface during extended wet periods. Permeability is slow.

The gently sloping, moderately well drained Glynwood soils are on rises and in dissected areas. The surface layer is silty clay loam. The content of organic matter is moderately low. A seasonal high water table is in the subsoil during extended wet periods. Permeability is slow.

Some of the minor soils in this association are the very poorly drained Pewamo and Millsdale soils in broad depressions and drainageways, the loamy Lobdell and Orrville soils on narrow flood plains, and the well drained Milton soils on bedrock-controlled rises.

Most areas of this association are used for row crops. The major soils are well suited to crops. They are moderately well suited or poorly suited to building site development and septic tank absorption fields.

Seasonal wetness, ponding, and erosion are the main limitations if these soils are used for farming. The main management concerns are controlling erosion, improving or maintaining drainage systems, and maintaining tilth. Wetness and the shrink-swell potential are the main limitations on building sites. The Glynwood soils are better suited to building site development than the Blount and Pandora soils.

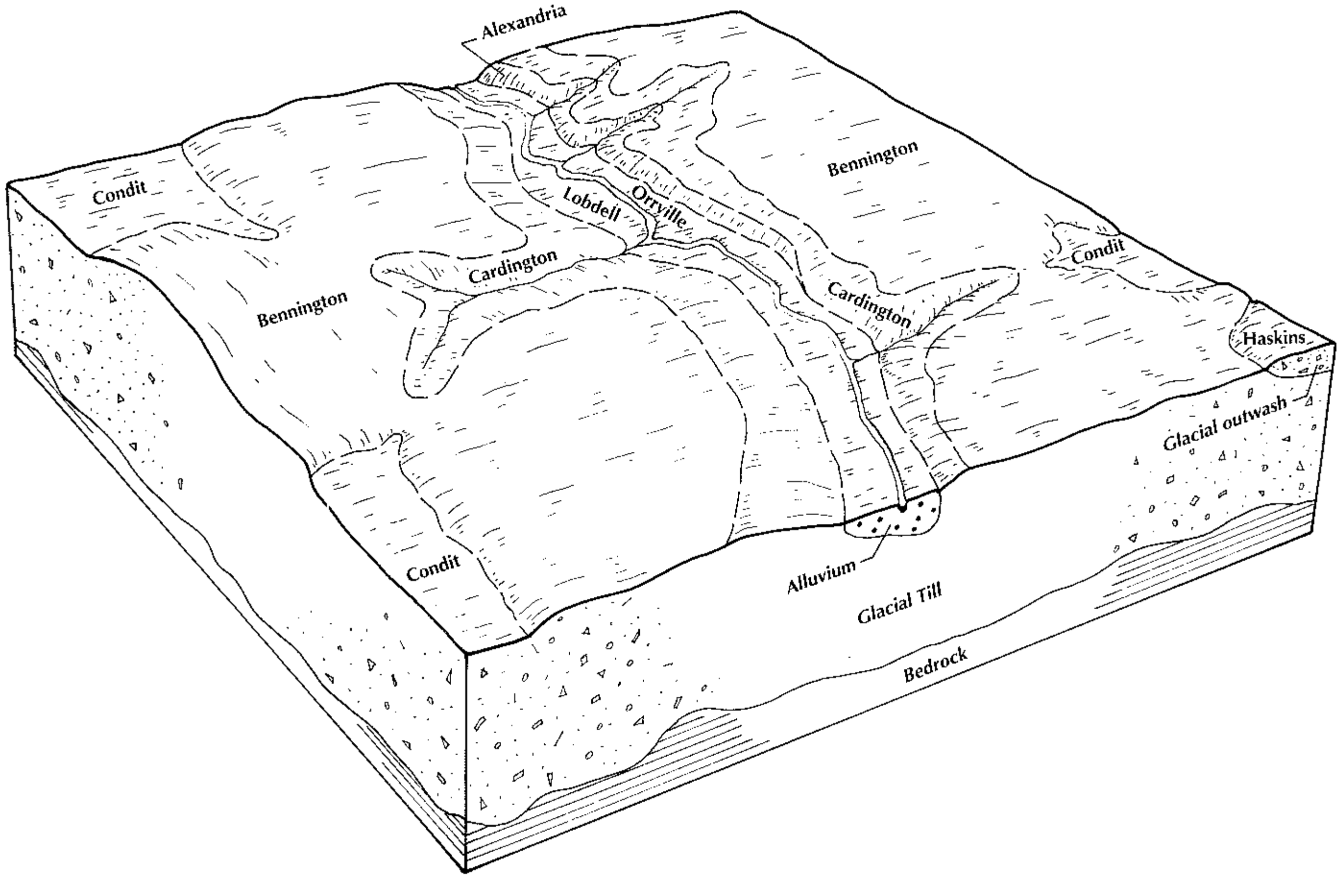

Figure 4.—Typical pattern of soils and parent material in the Bennington-Cardington-Condit association.

2. Bennington-Cardington-Condit Association

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

This association is on till plains. The landscape is characterized by broad, gently undulating slopes and flats. Most areas are drained by small, low-gradient streams and drainageways. Slope is 0 to 12 percent.

This association makes up about 50 percent of the county. It is about 60 percent Bennington soils, 10 percent Cardington soils, 10 percent Condit soils, and 20 percent soils of minor extent (fig. 4).

The nearly level and gently sloping, somewhat poorly drained Bennington soils are on broad flats and slight rises and in areas that are slightly dissected by small drainageways. The surface layer is silt loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is slow.

The gently sloping and sloping, moderately well drained Cardington soils are on rises, knolls, and the side slopes of drainageways. The surface layer is silt loam. The content of organic matter is moderate or low. A seasonal high water table is in the subsoil during extended wet periods. Permeability is slow or moderately slow.

The nearly level, poorly drained Condit soils are in shallow depressions and along low-gradient drainageways. The surface layer is silty clay loam. The content of organic matter is moderate. A seasonal high water table is near or above the surface during extended wet periods. Permeability is slow.

Some of the minor soils in this association are Haskins soils, which have less clay in the upper part of the subsoil than the major soils and are on slight rises on till plains and on stream terraces; Lobdell and Orrville soils, which formed in alluvium on flood plains along minor streams; and the well drained Alexandria soils, which are on moderately steep and very steep side slopes adjacent to small streams.

Most areas of this association are used for corn, soybeans, winter wheat, or hay. Some areas are used as pasture. The major soils are well suited or moderately well suited to crops. They are well suited, moderately well suited, or poorly suited to building site development and are poorly suited to septic tank absorption fields.

Seasonal wetness, ponding, and erosion are the main limitations if these soils are used for farming. The main management concerns are improving or maintaining drainage systems, controlling erosion, and maintaining tilth. Wetness, the shrink-swell potential, and ponding are the main limitations on building sites, and wetness and slow or moderately slow permeability are the main limitations on sites for septic tank absorption fields. The Cardington soils are better suited to building site development than the Bennington and Condit soils.

3. Cardington-Bennington Association

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

This association is on till plains. It is on end moraines and the dissected parts of ground moraines. The landscape is characterized by smooth, gentle slopes on the ground moraines and by shorter, more complex slopes on the end moraines. Most areas are drained by small, well defined waterways. Slope is 0 to 12 percent.

This association makes up about 30 percent of the county. It is about 50 percent Cardington soils, 20 percent Bennington soils, and 30 percent soils of minor extent.

The gently sloping and sloping, moderately well drained Cardington soils are on rises, knolls, and the side slopes of drainageways. The surface layer is silt loam. The content of organic matter is moderate or low. A seasonal high water table is in the subsoil during extended wet periods. Permeability is slow or moderately slow.

The nearly level and gently sloping, somewhat poorly drained Bennington soils are in the broader, less sloping areas on the till plains. The surface layer is silt loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is slow.

Some of the minor soils in this association are the poorly drained Condit soils in depressions and narrow drainageways, the loamy Lobdell and Orrville soils on flood plains along minor streams, the well drained Chili soils on stream terraces and rises on the till plains, and the well drained Alexandria soils on moderately steep and very steep valley side slopes.

Most areas of this association are used for corn, soybeans, winter wheat, or hay. Some areas are used as pasture. The nearly level and gently sloping soils are well suited to crops. The major soils are well suited, moderately well suited, or poorly suited to building site development and are poorly suited to septic tank absorption fields.

Erosion and seasonal wetness are the main limitations if these soils are used for farming. The main management concerns are controlling erosion, improving or maintaining drainage systems, and maintaining tilth. Wetness and a moderate shrink-swell potential are the main limitations on building sites, and wetness and moderately slow or slow permeability are the main limitations on sites for septic tank absorption fields. The Cardington soils are better suited to building site development than the Bennington soils.

4. Tiro-Condit Association

Deep, nearly level and gently sloping, somewhat poorly drained and poorly drained soils that formed in lacustrine sediment, glacial outwash, and glacial till

This association is on water-modified ground moraines on till plains. The landscape is characterized by broad, gently undulating slopes and by flats that have slight rises and shallow depressions. Most areas are drained by small, low-gradient drainageways and streams. Slope is 0 to 6 percent.

This association makes up less than 1 percent of the county. It is about 55 percent Tiro soils, 25 percent Condit soils, and 20 percent soils of minor extent.

The nearly level and gently sloping, somewhat poorly drained Tiro soils are on broad flats and slight rises and in areas that are dissected by small drainageways. The surface layer is silt loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is slow or moderately slow.

The nearly level, poorly drained Condit soils are in shallow depressions and along low-gradient drainageways. The surface layer is silty clay loam. The content of organic matter is moderate. A seasonal high water table is at, near, or slightly above the surface during extended wet periods. Permeability is slow.

Some of the minor soils in this association are the moderately well drained Cardington soils on the most pronounced knolls and rises, the very poorly drained Lenawee and Wallkill soils in the lowest and largest depressions, and Orrville soils, which formed in alluvium on narrow flood plains.

Most areas of this association are used for corn, soybeans, or winter wheat. The major soils are well suited or moderately well suited to crops. They are well suited, moderately well suited, or poorly suited to building site development and are poorly suited to septic tank absorption fields.

Seasonal wetness and erosion are the main limitations if these soils are used for farming. The main management concerns are improving or maintaining drainage systems, controlling erosion, and maintaining tilth. Wetness and ponding are the main limitations on building sites, and slow permeability and ponding are the main limitations on sites for septic tank absorption fields. The Tiro soils are better suited to building site development and septic tank absorption fields than the Condit soils.

5. Pewamo-Fries-Bennington Association

Deep and moderately deep, nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in lacustrine sediment and glacial till

This association is on lake plains and till plains. The landscape is characterized by broad flats and slight rises. Most areas are drained by ditches and small, low-gradient streams. Slope is 0 to 6 percent.

This association makes up about 6 percent of the county. It is about 55 percent Pewamo soils, 10 percent Fries soils, 10 percent Bennington soils, and 25 percent soils of minor extent.

The nearly level, very poorly drained Pewamo and Fries soils are on broad flats and in depressions. The Pewamo soils are deep, and the Fries soils are moderately deep. The surface layer of both soils is silty clay loam. The content of organic matter is high. A seasonal high water table is at or above the surface during extended wet periods. Permeability is moderately slow in the Pewamo soils and slow in the Fries soils.

The deep, nearly level and gently sloping, somewhat poorly drained Bennington soils are on slight rises. The surface layer is silt loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is slow.

Some of the minor soils in this association are Colwood, Haskins, Jimtown, Oshtemo, and Prout soils. All of the minor soils have less clay in the subsoil than the major soils. Colwood soils are on broad flats. Haskins, Jimtown, and Prout soils are on slight rises. The well drained Oshtemo soils are on low beach ridges on lake plains and water-modified till plains.

Most areas of this association are used for corn, soybeans, winter wheat, or hay and pasture. The major soils are well suited or moderately well suited to crops. They are well suited, moderately well suited, poorly suited, or generally unsuited to building site development and are poorly suited or generally unsuited to septic tank absorption fields.

Ponding, seasonal wetness, and erosion are the main limitations if these soils are used for farming. The main management concerns are improving or maintaining drainage systems, controlling erosion, and maintaining tilth. Wetness, ponding, the shrink-swell potential, very slow permeability, and the depth to bedrock are the main limitations on building sites, and wetness, ponding, seepage, and the depth to bedrock are the main limitations on sites for septic tank absorption fields. The Bennington soils are better suited to building site development than the Pewamo and Fries soils.

Moderately Deep Soils on Uplands

These soils make up less than 1 percent of the county. They are nearly level and gently sloping and are very poorly drained and well drained. They formed in glacial till and in limestone and dolomite residuum. The landscape is characterized by flats that have slight depressions and by low knolls and ridges on lake plains and till plains. The soils are used mainly as cropland. Wetness, ponding, droughtiness, the depth to bedrock, and the hazard of erosion are the main management concerns.

6. Millsdale-Milton-Castalia Association

Moderately deep, nearly level and gently sloping, very poorly drained and well drained soils that formed in glacial till and material weathered from limestone

This association is on bedrock-controlled uplands. The landscape is characterized by flats that have slight depressions and by low knolls and ridges. Slope is 0 to 6 percent.

This association makes up less than 1 percent of the county. It is about 50 percent Millsdale soils, 20 percent Milton soils, 10 percent Castalia soils, and 20 percent soils of minor extent.

The nearly level, very poorly drained Millsdale soils are on flats and in depressions. The surface layer is silty clay loam. The content of organic matter is high. A seasonal high water table is at or near the surface during extended wet periods. Permeability is moderately slow. Available water capacity is low.

The gently sloping, well drained Milton soils are on knolls and slight rises. The surface layer is silt loam. The content of organic matter is moderate. Permeability is moderate or moderately slow. Available water capacity is low.

The gently sloping, well drained Castalia soils are on knolls and slight rises. The surface layer is channery silt loam. The content of organic matter is moderate.

Permeability is rapid. Available water capacity is very low.

Some of the minor soils in this association are the deep Pewamo soils on broad flats; the somewhat poorly drained Haskins, Bennington, and Prout soils on slight rises; and the moderately well drained Elnora soils on rises and low beach ridges.

This association is used mainly for row crops. The major soils are moderately well suited or poorly suited to crops. They are well suited, moderately well suited, poorly suited, or generally unsuited to building site development and are generally unsuited to septic tank absorption fields.

Seasonal wetness, erosion, and droughtiness are the main limitations if these soils are used as cropland. The main management concerns are controlling erosion, conserving moisture, and improving or maintaining drainage systems. The depth to bedrock, ponding, the shrink-swell potential, and large stones are the main limitations on building sites, and the depth to bedrock, ponding, seepage, moderately slow permeability, and large stones are the main limitations on sites for septic tank absorption fields. These soils are better suited to buildings without basements than to buildings with basements. Because of poor filtration, the effluent in septic tank absorption fields can contaminate underground water supplies in the fractured bedrock.

Deep Soils on Upland Lake Plains, Outwash Plains, Terraces, Kames, Beach Ridges, and Till Plains

These soils make up about 11 percent of the county. They are nearly level to steep and are very poorly drained to well drained. They formed in lacustrine sediment, outwash, organic sediment, and glacial till. The landscape is characterized by broad flats and depressions that have slight rises and by ridges and hummocky, complex slopes. The soils are used mainly as cropland. Wetness, ponding, the hazard of erosion, moderately slow or slow permeability, and droughtiness are the main management concerns.

7. Colwood-Lenawee-Linwood Association

Deep, nearly level, very poorly drained soils that formed in lacustrine sediment, glacial outwash, and organic deposits

This association is in a postglacial lake basin. The landscape is characterized by broad flats and depressions. Most areas are drained by ditches and small, low-gradient streams. Slope is 0 to 2 percent.

This association makes up about 3 percent of the county. It is about 25 percent Colwood soils, 20 percent Lenawee soils, 15 percent Linwood soils, and 40 percent soils of minor extent.

The Colwood and Lenawee soils are on broad flats. The Colwood soils have a surface layer of silt loam, and the Lenawee soils have a surface layer of silty clay loam. The content of organic matter is high in both soils. A seasonal high water table is at or above the surface during extended wet periods. Permeability is moderate in the Colwood soils and moderately slow in the Lenawee soils.

The organic Linwood soils are in the lowest and broadest depressions on broad flats. The surface layer is muck. The content of organic matter is very high. A seasonal high water table is at or above the surface during extended wet periods. Permeability is moderately slow to moderately rapid in the organic material and moderate or moderately slow in the substratum.

Some of the minor soils in this association are the somewhat poorly drained Tiro and Kibbie soils on slight rises; the moderately well drained Tuscola soils on low knolls and ridges; Carlisle and Pinnebog soils, which have organic layers that are thicker than those of the Linwood soils and are on flats and in depressions; and Lenawee Variant soils, which have a subsoil that is more acid than that of the major soils and are on broad flats.

Most areas of this association are used for corn or soybeans. Some areas are used for specialty crops, and some are used as habitat for wildlife. The major soils are well suited to most crops. The Linwood soils are well suited to specialty crops. The major soils are poorly suited or generally unsuited to building site development and septic tank absorption fields.

Seasonal wetness is the main limitation if these soils are used for farming. The main management concern is improving or maintaining drainage systems. Wind erosion is a management concern on the Linwood soils. Ponding, low strength, and subsidence are the main limitations on building sites, and ponding and moderately slow permeability are the main limitations on sites for septic tank absorption fields.

8. Kibbie-Tuscola Association

Deep, nearly level and gently sloping, somewhat poorly drained and moderately well drained soils that formed in lacustrine sediment and glacial outwash

This association is on lake plains and outwash plains. The landscape is characterized by broad flats dissected by streams. The valley walls are steep. Slope is 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 45 percent Kibbie soils, 20 percent Tuscola soils, and 35 percent soils of minor extent (fig. 5).

The nearly level, somewhat poorly drained Kibbie

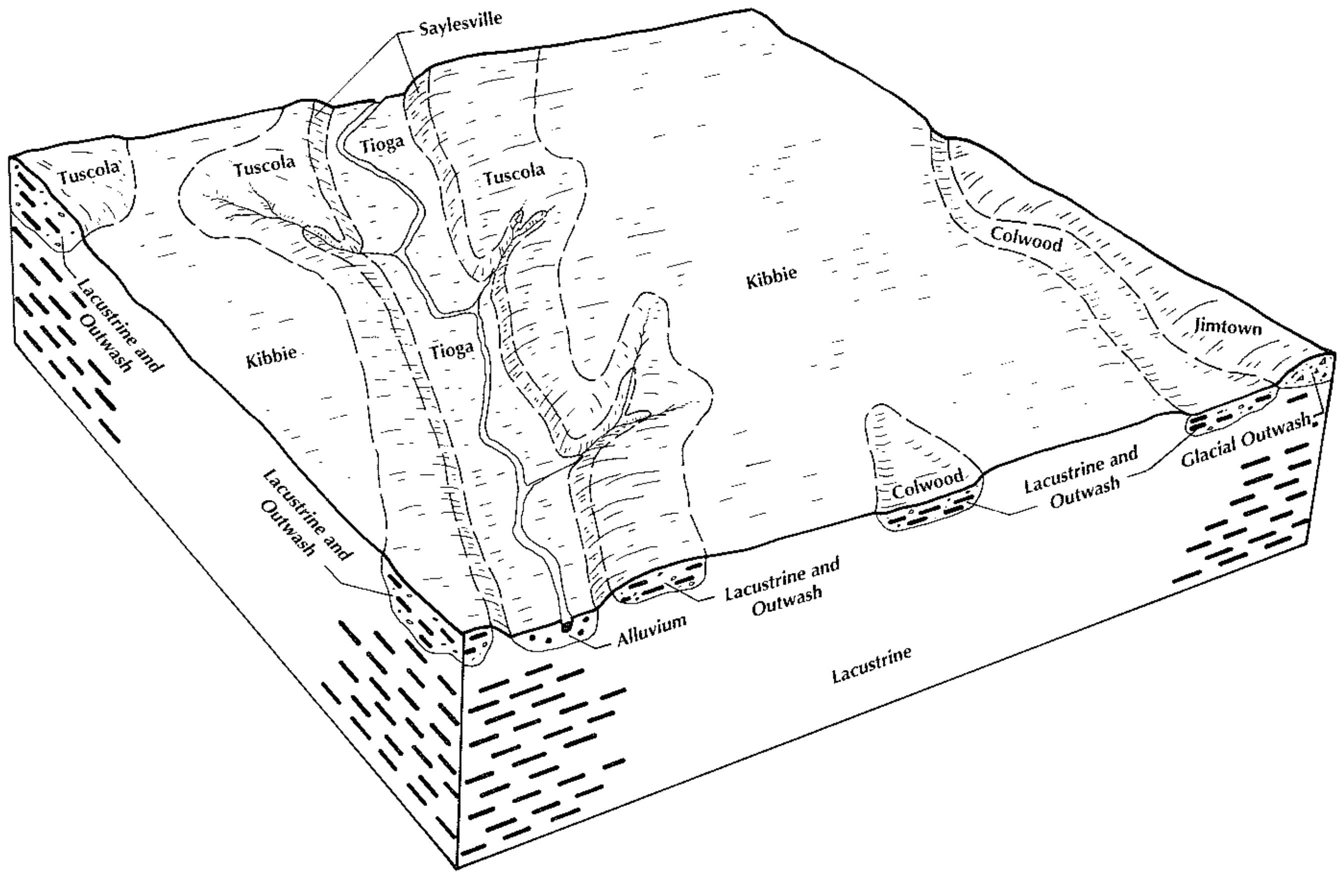

Figure 5.—Typical pattern of soils and parent material in the Kibbie-Tuscola association.

soils are on broad flats. The surface layer is loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is moderate.

The nearly level and gently sloping, moderately well drained Tuscola soils are on broad flats and slight rises and in dissected areas along drainageways. The surface layer is fine sandy loam. The content of organic matter is moderately low. A seasonal high water table is in the subsoil during extended wet periods. Permeability is moderate.

Some of the minor soils in this association are the well drained Saylesville soils on steep slopes along streams, the well drained Tioga soils on flood plains, the somewhat poorly drained Jimtown soils on slight rises, and the very poorly drained Colwood soils in shallow depressions on broad flats. Jimtown soils are underlain by gravelly outwash.

Most areas of this association are used for corn, soybeans, or winter wheat. The major soils are well suited to crops. They are well suited or moderately well suited to building site development and are poorly suited to septic tank absorption fields.

Seasonal wetness and erosion are the main limitations if these soils are used for farming. The main management concerns are improving or maintaining drainage systems and controlling erosion. Wetness and the shrink-swell potential are the main limitations on building sites, and wetness is the main limitation on sites for septic tank absorption fields. The Tuscola soils are better suited to building site development than the Kibbie soils.

9. Chili-Oshtemo-Haskins Association

Deep, nearly level to steep, well drained and somewhat poorly drained soils that formed in glacial outwash and in glacial outwash over glacial till or lacustrine sediment

This association is on beach ridges, outwash plains, terraces, kames, and till plains. The landscape is characterized by narrow ridges and by hummocky areas that have complex slopes. Most areas are drained by small, intermittent streams. Slope is 0 to 12 percent in some areas and 18 to 30 percent in others.

This association makes up about 3 percent of the county. It is about 30 percent Chili soils, 20 percent Oshtemo soils, 15 percent Haskins soils, and 35 percent soils of minor extent.

The gently sloping, sloping, and steep, well drained Chili soils are on knolls, ridges, and side slopes. The surface layer is loam. The content of organic matter is moderate or moderately low. Permeability is moderately rapid.

The gently sloping, well drained Oshtemo soils are on ridges. The surface layer is fine sandy loam. The content of organic matter is moderately low. Permeability is moderately rapid in the solum and very rapid in the substratum.

The nearly level, somewhat poorly drained Haskins soils are at the base of beach ridges and on the broader slopes. The surface layer is loam. The content of organic matter is moderate. A seasonal high water table is in the upper part of the subsoil during extended wet periods. Permeability is moderate in the upper part of the profile and slow in the lower part.

Some of the minor soils in this association are the sandy Spinks soils on knolls and the higher beach ridges; the moderately well drained Tuscola soils along drainageways; Jimtown soils on the lower slopes; and the very poorly drained Colwood soils in depressions. Jimtown soils are underlain by gravelly outwash.

Most areas of this association are used for corn, soybeans, winter wheat, or specialty crops. Many areas are used for building site development. The nearly level to sloping soils are well suited or moderately well suited to crops. The major soils are well suited or moderately well suited to building site development and are well suited, moderately well suited, poorly suited, or generally unsuited to septic tank absorption fields.

Erosion, droughtiness, and wetness are the main limitations if these soils are used as cropland. The main management concerns are controlling erosion, conserving moisture, and improving or maintaining drainage systems. The gently sloping Chili and Oshtemo soils have few or slight limitations if they are used as sites for buildings and septic tank absorption fields. The slope limits the use of the sloping and steep Chili soils as sites for buildings and septic tank absorption fields. In areas of the Haskins soils, wetness is the main limitation affecting building site development and wetness and restricted permeability are the main limitations affecting septic tank absorption fields.

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 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 the heading "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 substratum, 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 substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bennington silt loam, 0 to 2 percent slopes, is a phase of the Bennington series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, 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. Chili-Udorthents complex, 18 to 30 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits 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.

Some soil boundaries and soil names on the detailed soil maps of this county do not fully match those in the surveys of adjoining counties that were published at an earlier date. Most differences result from a better knowledge of soils or from modifications and refinements in the concepts of soil series. Some differences result from the predominance of different soils in map units consisting of soils of two or more series and from variations in the range in slope allowed within the map units in different surveys.

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

AcF—Alexandria silt loam, 25 to 50 percent slopes. This deep, very steep, well drained soil is on the side slopes along streams and drainageways on till plains. Most areas are 10 to 50 acres in size and are long and narrow.

Typically, the surface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is firm silty clay loam about 22 inches thick. The upper part is yellowish brown, and the lower part is dark yellowish brown and dark brown. The substratum to a depth of about 60 inches is brown, firm silty clay loam. In some areas the soil is eroded and has a surface layer of silty clay loam and a thinner solum. In other areas the subsoil has less clay and more sand.

Included with this soil in mapping are small areas of Chili soils. These soils are underlain by sand and gravel. They are on bench terraces. Also included are some areas of soils that are underlain by shale or sandstone and are on the upper part of the slopes and some areas of soils that are moderately steep. Included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Alexandria soil. Available water capacity is moderate. The content of organic matter is moderately low. The potential for frost action is moderate. Runoff is very rapid. The seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. The rooting depth is restricted mainly to the 24- to 36-inch zone above compact glacial till.

Most areas are used as woodland. A few areas are used as pasture.

This soil generally is unsuited to crops and pasture because of the slope. If the soil is used as pasture, the slope, the hazard of erosion, surface compaction, and the level of fertility are the main management concerns. The slope limits operation of the equipment used in seeding and in applying fertilizer. Restricted grazing when the soil is wet minimizes surface compaction and erosion. Grasses do not grow well during dry periods in summer.

This soil is moderately well suited to trees. The slope is the main management concern. Building logging roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a plant cover also help to control erosion. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil generally is unsuited to building site development, septic tank absorption fields, and most recreational uses because of the slope.

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

AdD2—Alexandria silty clay loam, 12 to 18 percent slopes, eroded. This deep, moderately steep, well drained soil is on side slopes on dissected till plains. Erosion has removed part of the original surface layer, and subsoil material has been tilled into the present surface layer. Most areas are long and narrow and are 10 to 100 acres in size.

Typically, the surface layer is brown, friable silty clay loam about 5 inches thick. The subsoil is about 22 inches of dark yellowish brown and brown, firm silty clay and silty clay loam. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam.

Included with this soil in mapping are areas of Bennington, Cardington, Condit, and Tuscola soils. The moderately well drained Cardington soils are on the lower or less sloping parts of most slopes. The moderately well drained Tuscola soils are in narrow areas on the upper part of the slopes. The somewhat poorly drained Bennington soils and the poorly drained Condit soils are in seep areas and along drainageways. Included soils make up about 20 percent of most areas.

Permeability is moderately slow in the Alexandria soil. Available water capacity is moderate. The content of organic matter is low. The potential for frost action is moderate. Runoff is very rapid. The seasonal high water table is at a depth of 48 to 72 inches during extended wet periods. The rooting depth is restricted mainly to the 24- to 36-inch zone above compact glacial till.

Most areas are used as pasture or woodland. Some areas are used as cropland.

This soil is poorly suited to row crops and small grain and is moderately well suited to grasses and legumes for hay and pasture. The hazard of erosion is severe if the soil is cultivated. Growing hay and pasture crops helps to control erosion. Minimizing tillage and tilling on the contour are effective in controlling erosion on cropland. The good natural drainage allows for early grazing of pastures in spring and favors the establishment of alfalfa.

This soil is moderately well suited to trees. The slope is the main management concern. Building logging roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is poorly suited to buildings and generally is unsuited to septic tank absorption fields. The slope and the moderately slow permeability are limitations. The hazard of erosion is severe if vegetation is removed. Immediate seeding of areas that are disturbed during construction can reduce the hazard of erosion. Buildings should be designed so that they conform to the natural slope of the land. The slope and the moderately slow permeability can cause the effluent in septic tank absorption fields to seep to the surface.

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

BgA—Bennington silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil generally is on flats on till plains. In a few areas it is on slight rises on lake plains. Most areas are irregularly shaped and are 20 to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The subsoil is about 29 inches of yellowish brown, brown, and dark

Figure 6.—A drainage ditch in an area of Bennington silt loam, 0 to 2 percent slopes.

yellowish brown, mottled, firm silty clay loam, clay, and silty clay. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled, firm clay loam. In some areas the surface layer is loam.

Included with this soil in mapping are small areas of Cardington, Condit, and Haskins soils. The moderately well drained Cardington soils are on slight rises and in sloping areas along drainageways. The poorly drained Condit soils are in depressions. Haskins soils have more sand and less clay in the subsoil than the Bennington soil. They are on slight rises. Included soils make up about 10 percent of most areas.

Permeability is slow in the Bennington soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is perched at a depth of 12 to 30 inches during extended wet periods. The rooting depth is restricted mainly to the 28- to 50-inch zone above compact glacial till.

Most areas are used as cropland. Some areas are used as woodland or pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is well suited to row crops and small grain. The wetness is the main limitation. Both surface and subsurface drainage systems help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring (fig. 6). Minimizing tillage and incorporating crop residue or other organic material into the surface layer improve tilth and fertility, increase the rate of water infiltration, and minimize surface crusting. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction.

This soil is well suited to pasture and hay, but it is poorly suited to grazing during extended wet periods. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth. The hay and pasture plants that are tolerant of wetness grow best.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to buildings and is poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to allow for good drainage. Enlarging the absorption area, using split-flow systems, and installing perimeter drains can increase the effectiveness of septic tank absorption fields. Adequate drainage outlets are not readily available in some areas.

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

BgB—Bennington silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil generally is on slight rises and in sloping areas along drainageways on till plains. In a few areas it is on slight rises on lake plains. Most areas are irregularly shaped and are 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 28 inches of yellowish brown, brown, and dark yellowish brown, mottled, firm silty clay loam and silty clay. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled, firm clay loam. In some areas the surface layer is loam.

Included with this soil in mapping are some small areas of Cardington and Condit soils. The moderately well drained Cardington soils are on the more prominent rises and in sloping areas along drainageways. The poorly drained Condit soils are in depressions and along drainageways. Included soils make up about 10 percent of most areas.

Permeability is slow in the Bennington soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is medium. The seasonal high water table is perched at a depth of 12 to 30 inches during extended wet periods. The rooting depth is restricted mainly to the 28- to 50-inch zone above compact glacial till.

Most areas are used as cropland. Some areas are used as woodland or pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is well suited to row crops and small grain. Erosion and wetness are the main management concerns. Leaving crop residue on the surface in fall and not plowing until spring help to protect the soil from erosion. Minimizing tillage and incorporating crop residue and other organic material into the surface layer improve tilth and fertility, increase the rate of water infiltration, and minimize surface crusting. Subsurface drains help to remove excess water during extended wet periods.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to buildings with basements and well suited to buildings without basements. It is poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to allow for good drainage. Enlarging the absorption area, using split-flow systems, and installing perimeter drains can increase the effectiveness of septic tank absorption fields.

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

BkA—Bixler loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on flats and low knolls on lake plains and beach ridges. Most areas are irregularly shaped and are 4 to 50 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 9 inches thick. The subsurface layer is brown, light yellowish brown, and pale brown, mottled, very friable loamy fine sand about 22 inches thick. The subsoil is about 12 inches of brown and grayish brown, mottled, friable fine sandy loam and silt loam stratified with silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, very friable loamy fine sand and fine sandy loam stratified with silt loam. In some areas the soil is underlain by glacial till. In other areas the surface layer is sandy loam or fine sandy loam.

Included with this soil in mapping are some areas of Colwood, Elnora, Kibbie, and Tuscola soils. The moderately well drained Elnora and Tuscola soils are on the more prominent rises. Kibbie and Colwood soils are in depressions. They have a dark surface layer. Included soils make up about 15 percent of most areas.

Permeability is rapid in the upper part of the Bixler soil and moderate in the lower part. Available water capacity is moderate. The content of organic matter is moderately low or low. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few small areas are wooded.

This soil is well suited to corn, soybeans, winter wheat, and specialty crops. The wetness and the hazard of wind erosion are the main management concerns. During extended dry periods droughtiness can be a problem. Wind erosion occurs when the plant cover is sparse or the surface is bare. Applying a system of conservation tillage that leaves crop residue on the surface and planting cover crops conserve moisture and reduce the hazard of wind erosion. Returning crop residue to the soil and adding other organic material improve fertility and increase the rate of water infiltration. A subsurface drainage system is effective in most farmed areas.

This soil is well suited to pasture and hay. No-till reseeding reduces the hazard of wind erosion.

This soil is well suited to trees. Seedlings cannot be established easily during the drier parts of the year. Planting seedlings that have been transplanted once can reduce the seedling mortality rate. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to building site development and is poorly suited to septic tank absorption fields. The wetness and seepage are the main limitations. Surface and subsurface drains help to lower the seasonal high water table. Some type of filtering material can be used to keep sand from filling subsurface drains. Properly grading building sites helps to keep surface water away from foundation walls. The soil is better suited to buildings without basements than to buildings with basements. Installing perimeter drains around septic tank absorption fields helps to lower the seasonal high water table. The sides of shallow excavations can cave in, especially when the soil is wet.

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

BoA—Blount silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises and extensive flats on till plains. Most areas are 10 to 200 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 31 inches of brown and dark yellowish brown, mottled, friable and firm silty clay loam and silty clay. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam glacial till. In a few areas the lower part of the subsoil and the substratum have less clay. In some areas the surface layer is loam.

Included with this soil in mapping are small areas of Glynwood and Pandora soils. The moderately well drained Glynwood soils are on low knolls. The poorly drained Pandora soils are in depressions and along drainageways. Included soils make up less than 15 percent of most areas.

Permeability is moderately slow or slow in the Blount soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is perched at a depth of 12 to 36 inches during extended wet periods. The rooting depth is restricted mainly to the 22- to 45-inch zone above compact glacial till.

Most areas are used as cropland. A few areas are used as woodland or pasture.

This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Seasonal wetness is the main management concern. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. No-till farming or another kind 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 surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction.

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

This soil is well suited to trees. A high content of clay in the subsoil is the main management concern.

Planting seedlings that have been transplanted once can reduce the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow.

This soil is moderately well suited to buildings and is poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. The soil is better suited to buildings without basements than to buildings with basements. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The limitations affecting septic tank absorption fields can be partially overcome by increasing the size of the absorption area or by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods.

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 on till plains. It generally is on low knolls and ridges or on slightly dissected slopes at the head of minor drainageways. Most areas are 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 21 inches of dark yellowish brown and brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam glacial till. In a few areas the lower part of the subsoil and the substratum have less clay. In some areas the surface layer is silty clay loam and is moderately eroded.

Included with this soil in mapping are small areas of Glynwood and Pandora soils. The moderately well drained Glynwood soils are on the crest of the more prominent knolls or in the more sloping areas. The poorly drained Pandora soils are in depressions and along drainageways. Also included are areas of Haskins soils, which have more sand and less clay in the subsoil than the Blount soil and are on slight rises. Included soils make up less than 15 percent of most areas.

Permeability is moderately slow or slow in the Blount soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is medium. The seasonal high water table is perched at a depth of 12 to 36 inches during extended wet periods. The rooting depth is restricted mainly to the 22- to 45-inch zone above compact glacial till.

Most areas are used as cropland. A few areas are used as woodland.

This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Erosion and seasonal wetness are the main management concerns. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. No-till farming or another kind 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 removing surface runoff and in reducing the hazard of 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 reduce the hazard of surface compaction.

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

This soil is well suited to trees. A high content of clay in the subsoil is the main management concern. Planting seedlings that have been transplanted once can reduce the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow.

This soil is moderately well suited to buildings with basements, well suited to buildings without basements, and poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during final grading hasten the reestablishment of a plant cover. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The limitations affecting septic tank absorption fields can be partially overcome by increasing the size of the absorption area or by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods. Measures that divert runoff from the higher adjacent soils reduce the wetness.

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

BrF—Brecksville silt loam, 40 to 70 percent slopes. This moderately deep, very steep, well drained soil is on dissected, bedrock-controlled side slopes along drainageways on uplands. Most areas are long and narrow and are 10 to 50 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 4 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 18 inches of yellowish brown, friable silt loam and shaly silt loam. Light olive brown, thinly bedded, soft shale bedrock is at a depth of about 29 inches. In some areas the surface layer and the upper part of the subsoil have more sand. In other areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Alexandria, Chili, and Saylesville soils. The deep Alexandria and Saylesville soils are on the upper part of side slopes. The deep Chili soils are on small benches. Also included, on the upper part of some slopes, are a few areas where the depth to bedrock is less than 20 inches. Included soils make up about 15 percent of most areas.

Permeability is slow in the Brecksville soil. Available water capacity is low. The content of organic matter is moderately low. The potential for frost action is moderate. Runoff is very rapid. The root zone is moderately deep to shale bedrock.

Most areas support mixed stands of native hardwoods. This soil generally is unsuited to crops and pasture. The slope is the main limitation. Farm machinery cannot easily cross the very steep slopes.

This soil is moderately well suited to trees. The slope is the main management concern. Building logging roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Erosion also can be controlled by water bars and a good plant cover. Selecting species that are tolerant of dry sites can reduce the seedling mortality rate.

This soil generally is unsuited to building site development and septic tank absorption fields because of the slope, the depth to bedrock, and the slow permeability.

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

CdB—Cardington silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on till plains. It is on knolls, slight rises, and dissected slopes along drainageways. Most areas are irregularly shaped and are 10 to several hundred acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown, mottled, friable silt loam. The lower part is brown, mottled, firm silty clay, clay, and clay loam. The substratum to a depth of about 60 inches is brown, mottled, very firm clay loam. In some areas the subsoil has more sand and less clay.

Included with this soil in mapping are some small areas of Alexandria, Bennington, and Condit soils. The somewhat poorly drained Bennington soils and the poorly drained Condit soils are along drainageways and in slight depressions at the base of slopes. The well drained Alexandria soils are on the more prominent rises and in areas that are transitional to steeper slopes. Also included, on the crest of some slopes, are some eroded spots of soils that have a surface layer of silty clay loam. Included soils make up about 15 percent of most areas.

Permeability is slow or moderately slow in the Cardington soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is medium. The seasonal high water table is at a depth of 18 to 36 inches during extended wet periods. The rooting depth is restricted mainly to the 28- to 50-inch zone above compact glacial till.

Most areas are used as cropland. A few small areas are used as woodland or pasture.

This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Erosion is the main hazard affecting most crops. Leaving crop residue on the surface in fall and not plowing until spring help to protect the soil from erosion. Minimizing tillage and incorporating crop residue and other organic material into the surface layer improve tilth and fertility, increase the rate of water infiltration, and minimize surface crusting. The natural drainage of this soil generally is adequate for farming, but randomly spaced subsurface drains are needed in areas of the more poorly drained included soils. Grassed waterways remove surface runoff and help to control erosion (fig. 7). Restricted grazing of pastures during wet periods minimizes damage to plants and surface compaction.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to buildings with basements and is well suited to buildings without basements. It is poorly suited to septic tank absorption fields. The wetness, the moderately slow permeability, and a moderate shrink-swell potential are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to prevent the structural damage caused by shrinking and swelling. Enlarging

Figure 7.—A well maintained grassed waterway in an area of Cardington silt loam, 2 to 6 percent slopes.

the absorption area and installing perimeter drains can increase the effectiveness of septic tank absorption fields. The soil is well suited to ponds (fig. 8).

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 till plains. It is on short side slopes along drainageways and on convex slopes in hummocky areas. Erosion has removed part of the original surface layer, and subsoil material has been tilled into the present surface layer. Most areas are long and narrow or irregularly shaped and are 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 24 inches of dark yellowish brown and brown, mottled, firm silty clay loam and silty clay. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, calcareous, firm silty clay loam glacial till. In some areas the surface layer has more sand. In other areas the subsoil and substratum have less clay.

Included with this soil in mapping are small areas of Alexandria, Bennington, and Condit soils. The well drained Alexandria soils are on the higher, more prominent rises and in the more hummocky areas. The somewhat poorly drained Bennington soils are on the lower part of the slopes. The poorly drained Condit soils are along drainageways and in depressions. Included soils make up about 10 percent of most areas.

Permeability is slow or moderately slow in the Cardington soil. Available water capacity is moderate. The content of organic matter is low. The potential for frost action is high. Runoff is rapid. The seasonal high water table is at a depth of 18 to 36 inches during extended wet periods. The rooting depth is restricted mainly to the 28- to 50-inch zone above compact glacial till.

Most areas are used as cropland. A few areas are used as woodland or pasture.

Corn, soybeans, and small grain and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to crops. Erosion is the main management concern. Because of erosion, the soil is less productive and cannot be easily managed. Tillage practices that leave crop residue on the surface help to control erosion. Grassed waterways slow concentrated runoff and help to control erosion. Including close-growing crops in the cropping system or delaying tillage until spring 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 reduce the hazard of surface compaction. Random subsurface drains are needed in areas of the wetter included soils. Pasture rotation, proper stocking rates, and deferment of grazing during extended wet periods help to keep pastures in good condition.

This soil is well suited to trees. Few limitations affect woodland management. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to buildings without basements and is poorly suited to buildings with basements and to septic tank absorption fields. The wetness, the slope, the moderately slow permeability, and a moderate shrink-swell potential are the main limitations. Building sites should be carefully chosen because natural drainageways and seep areas should be avoided. Erosion is a hazard during construction. Establishing a plant cover after construction may be difficult because of poor tilth. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Foundation walls should be strengthened so that they can withstand the shrinking and swelling of the soil. Porous backfill material that has a low shrink-

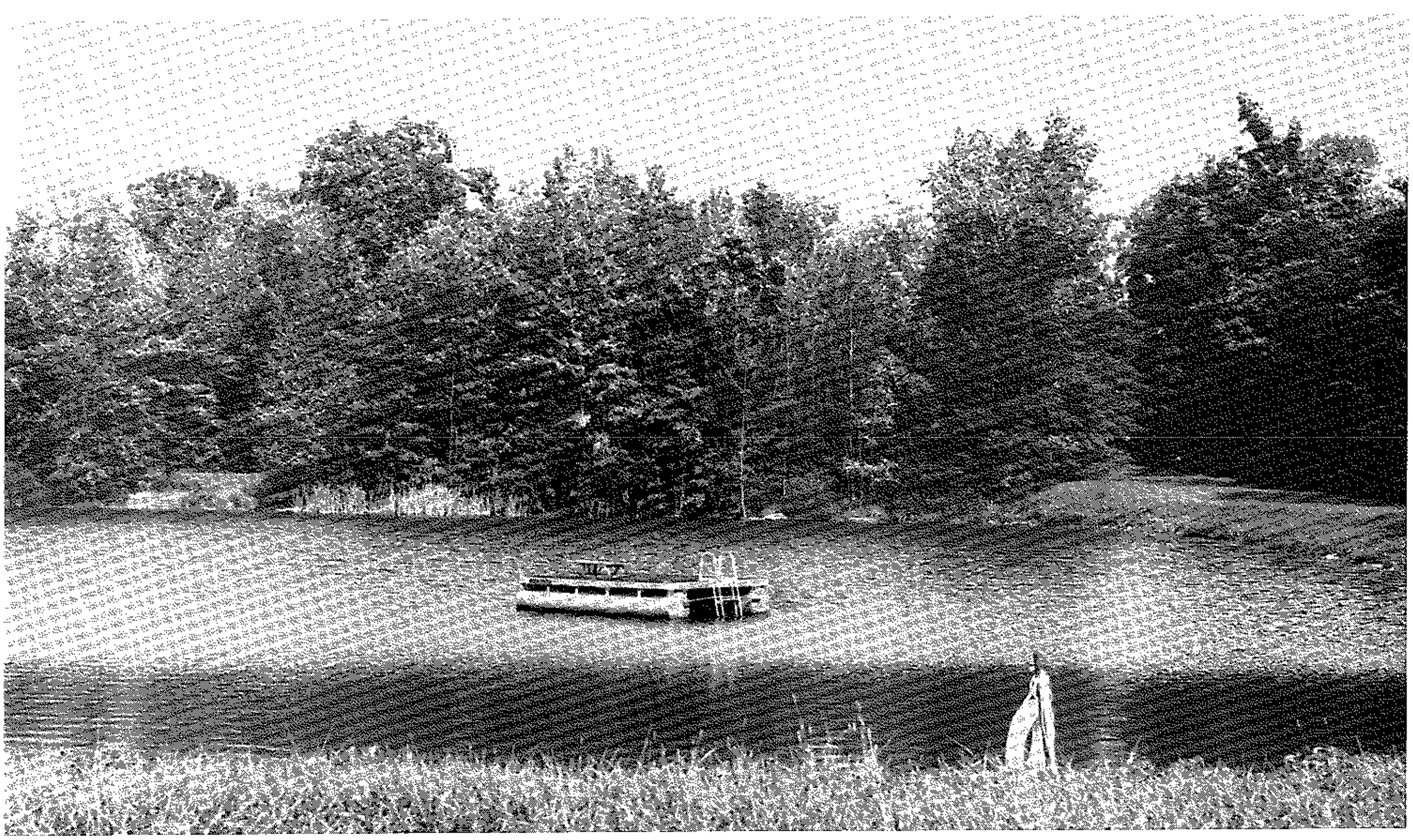

Figure 8.—A farm pond in an area of Cardington silt loam, 2 to 6 percent slopes.

Figure 9.—Harvesting celery in an area of Carlisle muck.

swell potential is needed to allow for good drainage and to prevent the structural damage caused by shrinking and swelling. The limitations affecting septic tank absorption fields can be partially overcome by increasing the size of the absorption area or by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during the wetter periods. 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.

Ce—Carlisle muck. This deep, level, very poorly drained, organic soil is in bogs on lake plains. The partially decomposed remains of plants have accumulated in these bogs. The soil is ponded for short periods. It occurs mainly as one large area that is several hundred acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is black, very friable muck about 9 inches thick. Below this to a depth of about 60 inches is dark reddish brown, black, and dark brown, friable muck that has some fibers and a few woody fragments. In some areas the subsurface layer has more fibrous material.

Included with this soil in mapping are some areas of Linwood soils. These soils have mineral material at a depth of 16 to 51 inches. Also included, along drainage ditches, are some areas that are covered with mineral material dredged from the ditches. Included soils make up about 10 percent of most areas.

Permeability is moderately slow to moderately rapid in the Carlisle soil. Available water capacity is very high. The content of organic matter also is very high. The potential for frost action is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used for vegetable crops, mainly onions, potatoes, celery (fig. 9), radishes, and lettuce. This soil is moderately well suited to vegetable crops. The wetness and acidity are the main limitations in the areas used for these crops. Surface drains and open ditches are used to remove excess water. Annual applications of lime reduce the acidity of the surface layer. Poor air drainage increases the hazard of frost late in spring and early in fall. When the surface dries, the lightweight, very friable muck is susceptible to wind erosion. Winter cover crops reduce the hazard of wind erosion.

This soil generally is unsuited to pasture and hay. Because the soil is soft when wet, grazing can cause considerable damage to pasture plants. The wetness and high acidity limit the productivity of most legumes.

This soil is poorly suited to trees. The wetness is the main management concern. Selecting species that are tolerant of seasonal wetness can reduce the seedling mortality rate. Harvesting procedures that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. Removing vines and the less desirable trees and shrubs can minimize plant competition. The trees should be logged during the drier parts of the year.

This soil generally is unsuited to building site development and septic tank absorption fields. The ponding, the wetness, low strength, and subsidence of the organic material are the main limitations.

The land capability classification is IIIw. The woodland ordination symbol is 6W.

Cf—Carlisle muck, ponded. This deep, level, very poorly drained, organic soil is in bogs on lake plains and till plains. The partially decomposed remains of plants have accumulated in these bogs. The soil is ponded for long periods. Most areas are oval or oblong and are 5 to 20 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is black, friable muck about 14 inches thick. Below this to a depth of about 60 inches is dark reddish brown and very dark gray, friable muck that has some fibers and a few woody fragments. In a few areas coprogenous material or silty lacustrine material is within 51 inches of the surface.

Included with this soil in mapping are small areas of Condit, Lenawee Variant, and Wallkill soils. The poorly drained Condit soils are in areas that are transitional to the uplands. The mineral Lenawee Variant soils are in landscape positions similar to those of the Carlisle soil. Wallkill soils have a surface layer of mineral alluvium. They are along drainageways. Included soils make up about 10 percent of most areas.

Permeability is moderately slow to moderately rapid in the Carlisle soil. Available water capacity is very high. The content of organic matter also is very high. The potential for frost action is high. Runoff is ponded. The seasonal high water table is near or above the surface for most of the year. The root zone is deep.

Most areas support wetland vegetation and provide habitat for wetland wildlife. This soil generally is unsuited to row crops and small grain and to grasses and legumes for hay and pasture. The wetness and the ponding are the main limitations affecting most crops. Surface and subsurface drains are effective, but adequate outlets cannot easily be established in most areas. Subsidence and shrinkage of the organic material can cause subsurface drains to shift and become ineffective. Ditchbanks are unstable. When wet, the soil cannot support farm machinery.

This soil generally is unsuited to trees. The fluctuating water level limits the survival of most tree species.

This soil generally is unsuited to building site development and septic tank absorption fields. The ponding, the wetness, low strength, and subsidence of the organic material are the main limitations. The soil is well suited to habitat for wetland wildlife.

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

CgB—Castalia channery silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on knolls and slight rises on uplands. Small, flat stones are on the surface. Most areas are oval or irregularly shaped and are 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, friable channery silt loam about 7 inches thick. The subsoil is reddish brown, friable very channery silt loam about 10 inches thick. The substratum is reddish brown extremely flaggy silt loam about 5 inches thick. Fractured limestone bedrock is at a depth of about 22 inches. In some small areas the surface layer is lighter colored. In a few areas it has a higher content of coarse fragments.

Included with this soil in mapping are small areas of Milton and Millsdale soils. Milton soils have fewer coarse fragments than the Castalia soil and have more clay in the subsoil. They are in landscape positions similar to those of the Castalia soil. The very poorly drained Millsdale soils are in depressions. Also included are some areas of soils that have bedrock at a depth of 10 to 20 inches. Included soils make up about 10 percent of most areas.

Permeability is rapid in the Castalia soil. Available water capacity is very low. The soil is droughty during dry periods. The content of organic matter is moderate. The potential for frost action also is moderate. Runoff is slow. The root zone is moderately deep to limestone bedrock.

Most areas are used as cropland. A few small areas are used as woodland.

This soil is poorly suited to crops and is moderately well suited to pasture. It is better suited to small grain than to corn and soybeans. Surface stones, droughtiness, and erosion are the main management concerns. Frost action also is a limitation. Pastures can be grazed early in spring. Surface stones and droughtiness are the main limitations in pastured areas. The grasses and legumes that are tolerant of droughtiness should be selected for planting.

This soil is poorly suited to trees. The species selected for planting should be those that are tolerant of droughtiness and the limited root zone. Surface stones limit the use of equipment. In most areas the trees can be logged around the stones.

This soil generally is unsuited to buildings with basements and is moderately well suited to buildings without basements. It generally is unsuited to septic tank absorption fields because of the stones and the bedrock at a depth of 20 to 40 inches. Before it is adequately filtered, the effluent in the absorption fields can move through cracks in the bedrock and pollute underground water supplies. Central sewage systems can be used, or the absorption fields can be installed in mounds of suitable material.

The land capability classification is IIIs. The woodland ordination symbol is 2D.

ChB—Chili loam, loamy substratum, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on slight rises and low knolls on outwash plains, terraces, beach ridges, kames, and till plains. Most areas are oval or long and narrow and are 5 to 50 acres in size.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil is about 37 inches thick. The upper part is brown, friable clay loam and brown, mottled, friable gravelly clay loam. The lower part is brown, mottled, friable gravelly loam and very friable very gravelly sandy loam. The substratum to a depth of about 60 inches is brown, very friable very gravelly sandy loam. In some areas the soil is eroded and has a higher content of coarse fragments in the surface layer. The surface layer is gravelly in some of these areas.

Included with this soil in mapping are small areas of Cardington, Jimtown, and Oshtemo soils. The somewhat poorly drained Jimtown soils and the moderately well drained Cardington soils are on the lower parts of the landscape. Oshtemo soils are on the more prominent rises. They are more sandy than the Chili soil. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the Chili soil. Available water capacity and the content of organic matter are moderate. The potential for frost action also is moderate. Runoff is medium. The root zone is deep.

Most areas are used as cropland. Some small areas are used as pasture. A few areas are wooded.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is well suited to row crops, small grain, and hay and pasture. Erosion is the main hazard affecting most crops. In periods of low rainfall, droughtiness may be a problem. Leaving crop residue on the surface in fall and not plowing until spring help to protect the soil from erosion. Minimizing tillage and incorporating crop residue and other organic material into the surface layer increase the rate of infiltration and help to maintain tilth and fertility. Since plant nutrients are leached at a relatively rapid rate, smaller, more frequent and timely applications of fertilizer and lime are needed. The soil is well suited to irrigation.

The good natural drainage of this soil permits grazing of pastures early in spring. If forage mixtures include alfalfa and clover, heavy applications of lime may be needed.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings and septic tank absorption fields. Few limitations affect these uses. Properly grading building sites helps to keep surface water away from foundation walls and septic tank absorption fields. The soil may not be suited to the construction of ponds because of the moderately rapid permeability.

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

ChC—Chili loam, loamy substratum, 6 to 12 percent slopes. This deep, sloping, well drained soil is on knolls and the side slopes of drainageways on outwash plains, terraces, kames, and till plains. Most areas are long and narrow or irregularly shaped and are 5 to 30 acres in size.

Typically, the surface layer is brown, friable loam about 9 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown and dark yellowish brown, friable clay loam and loam. The lower part is brown, friable very gravelly loam. The substratum to a depth of about 60 inches is brown, friable very gravelly loam. In a few places the surface layer is fine sandy loam. In some areas it is gravelly.

Included with this soil in mapping are some areas of Cardington, Jimtown, and Oshtemo soils. The moderately well drained Cardington soils have more clay and less sand than the Chili soil. They are on the lower slopes. The somewhat poorly drained Jimtown soils are in the less sloping areas below the Chili soil. Oshtemo soils contain more sand and less clay in the subsoil than the Chili soil. They are in some of the highest landscape positions. Also included, on the more sloping parts of the landscape, are a few areas of soils that have an eroded surface layer. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the Chili soil. Available water capacity is moderate. The content of organic matter is moderately low. The potential for frost action is moderate. Runoff is medium. The root zone is deep.

Most areas are used as cropland. Some areas are used as pasture. A few areas are used as woodland.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to crops and pasture. Erosion and droughtiness are the main management concerns. The soil dries early in spring, and plants often show evidence of moisture stress late in summer. Crops that mature earlier in the growing season grow better than other crops. No-till farming or another kind of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and reduces the hazard of erosion. Returning crop residue to the soil and adding other organic material can improve tilth and fertility. Grassed waterways slow concentrated runoff and help to control erosion. Plant nutrients are leached at a moderately rapid rate from this soil. As a result, crops generally respond better to frequent applications of small amounts of fertilizer and lime than to one large application.

The good natural drainage of this soil permits grazing of pastures early in spring. The pasture species selected for seeding should be those that are tolerant of droughtiness.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings and septic tank absorption fields. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Erosion is a hazard during construction. It can be controlled by maintaining as much vegetation as possible on the site during construction. The sides of shallow excavations can cave in. The effluent in septic tank absorption fields drains freely. If it is not adequately filtered, however, it can contaminate shallow underground water supplies.

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

CkE—Chili-Udorthents complex, 18 to 30 percent slopes. These deep, steep, well drained soils are on the side slopes of kames. The Chili soil is on undisturbed side slopes, and the Udorthents are mainly in areas where gravel and sand have been removed. Chili fine sandy loam makes up about 50 to 70 percent of most areas, and Udorthents make up 20 to 40 percent. The soils occur as areas so intricately intermingled that mapping them separately is not practical. Most areas are irregularly shaped and are 10 to more than 100 acres in size.

Typically, the Chili soil has a surface layer of brown, friable fine sandy loam about 10 inches thick. The subsoil to a depth of more than 60 inches is brown and dark yellowish brown, friable fine sandy loam, sandy loam, and gravelly clay loam.

The Udorthents are loamy soils that have been altered by cutting, filling, or leveling. They are mainly in areas of old gravel pits. In areas that have been cut, the remaining soil material typically is similar to that in the subsoil or substratum of the adjacent Chili soil. In fill areas the characteristics of the soil material are more varied. This material generally is derived from the subsoil and substratum of nearby soils. Clay loam glacial till or fine textured material is at the base of some of the pits.

Included in this unit in mapping are the well drained Oshtemo soils and small areas of soils that have a large amount of cobbles throughout and are on steep side slopes. Oshtemo soils have less clay in the subsoil than the Chili soil. Also included, on ridgetops, are some areas where the slope is less than 18 percent. Included soils make up 10 to 15 percent of most areas.

In areas of the Chili soil, permeability is moderately rapid, available water capacity is moderate, the content of organic matter is moderately low, the potential for frost action is moderate, runoff is rapid, and the root zone is deep. The characteristics of the Udorthents vary considerably.

Most areas are used as woodland or pasture.

These soils are generally unsuited to crops because of the slope and a severe hazard of erosion. They are poorly suited to pasture. The hazard of erosion and the slope are the major management concerns. Overgrazing can result in erosion. A permanent plant cover is the best means of controlling erosion. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. The slope limits the use of equipment.

These soils are moderately well suited to trees. Erosion can be controlled by building logging roads and skid trails on the contour and establishing water bars. Operating mechanical tree planters and mowers that control plant competition is very difficult because of the slope. Removing vines and the less desirable trees and shrubs can minimize plant competition.

These soils are generally unsuited to building site development and septic tank absorption fields because of the slope. The included areas on the less sloping ridgetops are better suited to building site development. Cutting and filling increase the hazard of hillside slippage. The effluent in septic tank absorption fields drains freely. If it is not adequately filtered, however, it can contaminate shallow underground water supplies.

The land capability classification of the Chili soil is VIe. The woodland ordination symbol of the Chili soil is 4R. The Udorthents are not assigned a capability classification or a woodland ordination symbol.

Cm—Colwood silt loam. This deep, nearly level, very poorly drained soil generally is on broad flats and in depressions on lake plains and outwash plains. In a few areas it is in depressions on till plains. The lower parts of the depressions are subject to ponding. Most areas are 5 to several hundred acres in size and are irregularly shaped. Slope is 0 to 2 percent.

Typically, the surface layer is black, friable silt loam about 11 inches thick. The subsoil is about 20 inches thick. The upper part is dark grayish brown and grayish brown, mottled, firm silty clay loam. The lower part is grayish brown, mottled, friable loam. The substratum to a depth of about 60 inches is light brownish gray and grayish brown, mottled, friable loam and silt loam. In some areas the surface layer is sandy loam. In other areas the soil has shale bedrock at a depth of 40 to 60 inches and has a more acid solum.

Included with this soil in mapping are small areas of Kibbie, Lenawee, Linwood, and Pewamo soils. The somewhat poorly drained Kibbie soils are on the highest part of the broad flats. Lenawee and Pewamo soils have more clay and less sand in the subsoil than the Colwood soil. They are in landscape positions similar to those of the Colwood soil. The organic Linwood soils are in the lowest depressions. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Colwood soil. Available water capacity is very high. The content of organic matter is high. The potential for frost action also is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland. This soil is especially well suited to corn, soybeans, and wheat if a drainage system is installed. Cultivated crops can be grown year after year if optimum management is applied. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction. A drainage system is essential in areas of cropland. Surface and subsurface drainage systems help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. Grade-changing structures in areas where surface drains enter the deeper outlet ditches help to control erosion.

This soil is moderately well suited to pasture. Seasonal wetness is the main management concern.

This soil is moderately well suited to trees. The wetness is the main management concern. Selecting seedlings that are tolerant of seasonal wetness reduces the seedling mortality rate. Planting seedlings that have been transplanted once also reduces the seedling mortality rate. Frequent, light thinning and harvesting increase the vigor of the stand and reduce the hazard of windthrow. Plant competition in the existing stands can be controlled by removing the less desirable trees and shrubs. The trees can be logged during the drier parts of the year.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding is the main hazard. Ditches and subsurface drains can improve drainage if adequate outlets are available. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The sides of shallow excavations can cave in, especially when the soil is wet. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods.

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

Co—Condit silty clay loam. This deep, nearly level, poorly drained soil is in shallow depressions and along drainageways on till plains. The lowest part of the depressions is subject to ponding by runoff from the higher adjacent soils. Most areas are long and narrow or irregularly shaped and are 10 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 2 inches thick. The subsurface layer is dark gray, mottled, friable silty clay loam about 4 inches thick. The subsoil is about 38 inches thick. The upper part is grayish brown, mottled, firm silty clay loam and silty clay, and the lower part is grayish brown and gray, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled, firm silty clay loam and silt loam. In cultivated areas the surface layer is thicker. In a few areas it is silt loam.

Included with this soil in mapping are small areas of Bennington, Colwood, Lenawee, and Pewamo soils.

The somewhat poorly drained Bennington soils are on the highest part of slight rises. The very poorly drained Colwood, Lenawee, and Pewamo soils are in the lowest depressions and along drainageways. Also included are small wet spots and closed depressions that remain wet for long periods and cannot be easily drained. Included soils make up about 10 percent of most areas.

Permeability is slow in the Condit soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The rooting depth is restricted mainly to the 30- to 55-inch zone above compact glacial till.

Most areas are used as cropland. Many areas are used as woodland. A few areas are used as pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to row crops. The wetness and the ponding are the main limitations affecting most crops. Surface and subsurface drains are used to remove excess water. Adequate outlets for subsurface drains are not readily available in some areas. The soil becomes compacted and cloddy if worked when wet. Returning crop residue to the soil and adding other organic material minimize clodding and crusting, improve fertility, and increase the rate of water infiltration.

This soil is poorly suited to pasture. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth. The hay and pasture plants that are tolerant of wetness grow best.

This soil is moderately well suited to trees. The wetness is the main management concern. Selecting seedlings that are tolerant of seasonal wetness and a high content of clay in the subsoil reduces the seedling mortality rate. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. The trees can be logged during the drier parts of the year.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to allow for good drainage. Enlarging the absorption area and installing perimeter drains can increase the effectiveness of septic tank absorption fields. Adequate drainage outlets are not readily available in some areas.

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

EnA—Elnora loamy fine sand, 1 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on slight rises on low beach ridges, sand dunes, lake plains, and deltas. Most areas are circular or irregularly shaped and are 5 to 40 acres in size.

Typically, the surface layer is dark brown, very friable loamy fine sand about 14 inches thick. The subsoil is yellowish brown and dark yellowish brown, very friable loamy fine sand about 26 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown and dark yellowish brown, mottled, loose loamy fine sand. In some areas the lower part of the subsoil and the substratum have a higher content of coarse fragments.

Included with this soil in mapping are small areas of Bixler, Kibbie, Oshtemo, Spinks, and Tuscola soils. The somewhat poorly drained Bixler and Kibbie soils are in the more nearly level areas on the lowest part of the landscape. The well drained Spinks and Oshtemo soils are in the highest areas. Tuscola soils are in landscape positions similar to those of the Elnora soil. Included soils make up about 10 percent of most areas.

Permeability is rapid in the Elnora soil. Available water capacity is low. The content of organic matter is moderate. The potential for frost action also is moderate. Runoff is slow. The seasonal high water table is at a depth of 18 to 24 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. Some areas are used for specialty crops.

This soil is well suited to corn, soybeans, small grain, and specialty crops. It is moderately well suited to grasses and legumes for hay and pasture. Droughtiness, wetness, and wind erosion are the main management concerns. Applying a system of conservation tillage that leaves crop residue on the surface, planting cover crops, and returning crop residue to the soil reduce the hazard of wind erosion, conserve moisture, and retard surface drying. Subsurface drains can lower the seasonal high water table. They can become filled with fine sand unless some type of filtering material is used. A good plant cover protects the soil against wind erosion. Shallow-rooted plants grow poorly during extended dry periods. Timely deferment of grazing, pasture rotation, selection of suitable species for planting, and weed control help to keep pastures in good condition.

This soil is moderately well suited to trees. The trees that are tolerant of wetness should be selected for planting. Planting seedlings that have been transplanted once or mulching can reduce the seedling mortality rate.

This soil is well suited to buildings without basements and is moderately well suited to buildings with basements and to septic tank absorption fields. The wetness is the main limitation. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. The sides of shallow excavations can cave in, especially when the soil is wet. Perimeter drains around septic tank absorption fields help to lower the seasonal high water table. The effluent in the absorption fields drains freely. If it is not adequately filtered, however, it can pollute shallow underground water supplies. Central sewage systems can be used, or alternative sewage treatment and disposal systems can be installed.

The land capability classification is IIIs. The woodland ordination symbol is 3S.

Fr—Fries silty clay loam. This moderately deep, nearly level, very poorly drained soil is on broad flats and in depressions on lake plains and till plains. The lower parts of the depressions are subject to ponding. Most areas are broad and irregularly shaped and are 20 to more than 500 acres in size. Slope is 0 to 2 percent.

Typically, the surface soil is very dark gray and black, firm silty clay loam about 14 inches thick. The subsoil is about 16 inches of dark gray and yellowish brown, mottled, firm silty clay loam and clay loam. Soft, weathered shale bedrock is at a depth of about 30 inches. In a few areas the surface layer is silt loam. In some areas it is lighter in color. In other areas the depth to bedrock is 40 to 60 inches.

Included with this soil in mapping are small areas of Pewamo and Prout soils. The deep Pewamo soils are in landscape positions similar to those of the Fries soil. The somewhat poorly drained Prout soils are on the highest part of slight rises. Included soils make up about 15 percent of most areas.

Permeability is slow in the Fries soil. Available water capacity is low. The content of organic matter is high. The potential for frost action is moderate. The shrink-swell potential is high in the surface layer and subsoil. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is moderately deep to shale bedrock.

Most areas are used as cropland. A few small areas are used as woodland.

This soil is moderately well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and is poorly suited to pasture. The wetness and the ponding are the main limitations affecting most crops. Surface and subsurface drains are needed to remove excess water, but the bedrock may interfere with the installation of subsurface drains. The soil becomes compacted and cloddy if tilled when wet. Returning crop residue to the soil and adding other organic material improve fertility, minimize clodding and crusting, and increase the rate of water infiltration.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth.

This soil is moderately well suited to trees. The wetness is the main management concern. The trees should be harvested during the drier parts of the year. Selecting species that are tolerant of seasonal wetness and a high content of clay in the subsoil can reduce the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to buildings without basements and is generally unsuited to buildings with basements and to septic tank absorption fields. The moderate depth to bedrock, the ponding, the slow permeability, and a high shrink-swell potential are the main limitations. The soil is better suited to buildings without basements than to buildings with basements. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings can remove excess water, but obtaining adequate drainage outlets may be difficult because of the limited depth to bedrock. Reinforcing foundations and footings and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. The effluent in septic tank absorption fields can seep into fractures in the bedrock and pollute underground water supplies.

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

GwB2—Glynwood silty clay loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on till plains. It is on slight rises and in sloping areas along drainageways. Erosion has removed part of the original surface layer, and subsoil material has been tilled into the present surface layer. Most areas are irregularly shaped and are 10 to more than 200 acres in size.

Typically, the surface layer is brown, friable silty clay loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is yellowish brown and dark yellowish brown, mottled, firm silty clay. The lower part is brown and dark yellowish brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam. In some areas the soil has more sand and less clay throughout.

Included with this soil in mapping are some small areas of the somewhat poorly drained Blount and poorly drained Pandora soils on the lowest part of slight depressions, along drainageways, and on the lower part of the slopes. Also included are a few areas of well drained soils that are transitional to steeper slopes, some less sloping areas where the soils are only slightly eroded and have a surface layer of silt loam, and a few areas of soils that have a slope of more than 6 percent. Included soils make up about 15 percent of most areas.

Permeability is slow in the Glynwood soil. Available water capacity is moderate. The content of organic matter is moderately low. The potential for frost action is high. Runoff is medium. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The rooting depth is restricted mainly to the 16- to 40-inch zone above compact glacial till.

Most areas are used as cropland. Some areas are used as pasture or woodland.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to row crops, small grain, and pasture. Erosion is the main hazard affecting most crops. Leaving crop residue on the surface in fall and not plowing until spring help to protect the soil from erosion. Minimizing tillage and incorporating crop residue and other organic material into the surface layer improve tilth and fertility, increase the rate of water infiltration, and minimize surface crusting. The natural drainage of this soil generally is adequate for farming, but randomly spaced subsurface tile is needed in areas of the wetter included soils. Restricted grazing of pastures during wet periods minimizes damage to plants and surface compaction.

This soil is well suited to trees. A high content of clay in the subsoil is the main management concern. Planting seedlings that have been transplanted once can reduce the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements and is moderately well suited to buildings with basements. It is poorly suited to septic tank absorption fields. The wetness, the slow permeability, and a moderate shrink-swell potential are the main limitations. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during final grading hasten the reestablishment of a plant cover. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to prevent the structural damage caused by shrinking and swelling. Enlarging the absorption area, using split-flow systems, and installing perimeter drains can increase the effectiveness of septic tank absorption fields. The perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods.

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

HkA—Haskins loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on the lower slopes on beach ridges and terraces and on slight rises on outwash plains and till plains. Most areas are 5 to more than 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 11 inches thick. The subsoil is about 31 inches thick. The upper part is brown and grayish brown, mottled, friable loam. The lower part is grayish brown and brown, mottled, firm clay loam and silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm clay loam glacial till. In a few areas the depth to glacial till is more than 40 inches. In a few places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Bennington, Cardington, Jimtown, and Tuscola soils. Bennington and Cardington soils have more clay and less sand in the subsoil than the Haskins soil. Bennington soils are in landscape positions similar to those of the Haskins soil. The moderately well drained Cardington soils are on low knolls. Jimtown soils are underlain by sand and gravel. They are in landscape positions similar to those of the Haskins soil. The moderately well drained Tuscola soils are on slight rises. Included soils make up less than 20 percent of most areas.

Permeability is moderate in the upper part of the subsoil in the Haskins soil and slow in the lower part and in the substratum. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. The rooting depth is restricted mainly to the 22- to 50-inch zone above compact glacial till.

Most areas are used as cropland. A few areas are used as woodland or pasture.

This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Seasonal wetness is the main management concern. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. No-till farming or another kind 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 surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction.

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

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements, moderately well suited to buildings with basements, and poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The included areas of moderately well drained soils are better sites for buildings than this soil. The limitations affecting septic tank absorption fields can be partially overcome by increasing the size of the absorption area and by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods. Measures that divert runoff from the higher adjacent soils reduce the wetness.

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

Ho—Holly silt loam, frequently flooded. This deep, nearly level, poorly drained soil is on flood plains. It is in depressions and at the base of upland side slopes. It is frequently flooded for brief periods in fall, winter, and spring. Most areas are 5 to 50 acres in size and are long and narrow or irregularly shaped. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 17 inches thick. The upper part is dark gray and gray, mottled, friable and firm silt loam and silty clay loam. The lower part is light gray, mottled, friable loam. The substratum to a depth of about 60 inches is light gray and gray, mottled, friable, stratified loam, sandy loam, and loamy sand. In a few places the soil has a dark surface layer. In some areas the subsoil has less sand and more silt. In other areas the soil is underlain by glacial till.

Included with this soil in mapping are small areas of Lobdell and Orrville soils. The moderately well drained Lobdell soils and the somewhat poorly drained Orrville soils are on the highest part of slight rises. Also included are small areas of organic soils in the lowest depressions along old oxbows and small areas of soils that are underlain by bedrock. Included soils make up about 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil of the Holly soil and moderate or moderately rapid in the substratum. Available water capacity is high. The content of organic matter is moderate. The potential for frost action is high. Runoff is slow or ponded. The seasonal high water table is at or near the surface during extended wet periods. The root zone is deep.

Most areas are used as pasture or woodland. A few areas are used as cropland.

This soil is poorly suited to row crops and winter wheat and to grasses and legumes for hay and pasture. The flooding and the wetness are the main limitations affecting most crops. They delay planting in most years and limit the choice of crops. Row crops, such as soybeans, can be planted later in the growing season, after the major threat of flooding has passed. Unless it is controlled, the flooding severely damages winter grain crops. Subsurface drains can remove excess water, but drainage outlets are not readily available in most areas. Planting cover crops, incorporating crop residue into the surface layer, and applying a system of conservation tillage help to maintain tilth and prevent surface crusting. Cover crops help to protect the surface in areas that are subject to scouring during periods of flooding.

The pasture species selected for seeding on this soil should be those that are tolerant of wetness. Pasture rotation and deferment of grazing during wet periods help to keep the pasture in good condition.

This soil is moderately well suited to trees. The trees should be planted and harvested during the drier parts of the year. The species that can withstand wetness should be selected for reforestation. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the wetness and the hazard of flooding.

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

JtA—Jimtown loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on the lower slopes on beach ridges and terraces and on slight rises on outwash plains. Most areas are 5 to more than 50 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 35 inches thick. The upper part is brown, dark yellowish brown, and grayish brown, mottled, friable and firm clay loam. The lower part is gray, mottled, friable gravelly loam. The substratum to a depth of about 60 inches is brown, mottled, stratified loamy sand and gravelly sandy loam. In a few areas the surface layer is sandy loam. In some areas the soil is underlain by bedrock.

Included with this soil in mapping are small areas of Chili, Colwood, and Haskins soils. The well drained Chili soils are on the highest part of low knolls. The very poorly drained Colwood soils are in the lowest depressions. Haskins soils are underlain by glacial till. They are in landscape positions similar to those of the Jimtown soil. Also included, on slight rises, are soils that are moderately well drained. Included soils make up less than 20 percent of most areas.

Permeability is moderate in the Jimtown soil. Available water capacity and the content of organic matter also are moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Seasonal wetness is the main management concern. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. No-till farming or another kind 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 surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction.

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

This soil is well suited to trees. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements and is moderately well suited to buildings with basements. It is poorly suited to septic tank absorption fields. The wetness is the main limitation. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The sides of shallow excavations can cave in. The limitations affecting septic tank absorption fields can be partially overcome by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods. Measures that divert runoff from the higher adjacent soils reduce the wetness.

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

KbA—Kibbie loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad flats on lake plains. Most areas are broad and irregularly shaped and are 20 to several hundred acres in size.

Typically, the surface layer is very dark gray, friable loam about 9 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown and brown, mottled, friable loam. The lower part is brown, mottled, friable loam that has thin strata of silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, friable silt loam. In some areas the soil does not have a dark surface layer. In other areas the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Colwood, Jimtown, Lenawee, and Tuscola soils. The very poorly drained Colwood and Lenawee soils are on the lowest part of slight depressions. Jimtown soils are underlain by outwash. They are in landscape positions similar to those of the Kibbie soil. The moderately well drained Tuscola soils are in slightly dissected areas. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Kibbie soil. Available water capacity is high. The content of organic matter is moderately low. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 12 to 24 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few areas are wooded.

Corn, soybeans, and winter wheat commonly are grown on this soil. The soil is well suited to row crops and specialty crops. Wetness is the main limitation. Surface and subsurface drains are needed, but suitable drainage outlets cannot be easily established in some areas. The soil can be easily tilled. Incorporating crop residue or other organic material into the surface layer increases the rate of water infiltration, improves tilth, and improves the soil-to-seed contact.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet can cause surface compaction and damage pasture plants. The hay and pasture plants that are tolerant of wetness grow best.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements and is moderately well suited to buildings with basements. It is poorly suited to septic tank absorption fields. The wetness is the main limitation. Properly grading building sites helps to keep surface water away from foundation walls. Foundation drains and coatings on the exterior of basement walls help to keep basements dry. Perimeter drains around septic tank absorption fields help to lower the seasonal high water table. The sides of shallow excavations can cave in, especially when the soil is wet.

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

Le—Lenawee silty clay loam. This deep, nearly level, very poorly drained soil is on flats on lake plains and in depressions on till plains. It is subject to ponding by runoff from the higher adjacent soils. Most areas are broad and irregularly shaped and are 20 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. The subsoil is about 28 inches of dark gray and gray, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is olive brown, mottled, firm silty clay loam stratified with silt loam and very fine sandy loam. In a few areas adjacent to small streams, the soil has a thin surface layer of overwash material.

Included with this soil in mapping are small areas of Colwood, Lenawee Variant, and Pewamo soils. Colwood soils have a dark surface layer that is thicker than that of the Lenawee soil and contain more sand and less clay in the subsoil. Lenawee Variant soils are more acid in the subsoil and substratum than the Lenawee soil. Pewamo soils have a dark surface layer that is thicker than that of the Lenawee soil and are underlain by glacial till. Colwood, Lenawee Variant, and Pewamo soils are in landscape positions similar to those of the Lenawee soil. Also included, in depressions, are a few small areas of soils that have a surface layer of muck. Included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Lenawee soil. Available water capacity and the content of organic matter are high. The potential for frost action also is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland. Some areas are wooded.

This soil is well suited to corn, soybeans, small grain, and hay and is moderately well suited to pasture. Seasonal wetness and the hazard of compaction are the main management concerns. A drainage system is essential in areas of cropland. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in spring. In some areas drainage outlets are ineffective during periods of flooding in the surrounding ditches and streams. Applying a system of conservation tillage and limiting fieldwork when the soil is wet reduce the hazard of surface compaction. A good meadow rotation can improve drainage. Grassed waterways slow and direct the movement of water.

The pasture species selected for seeding on this soil should be those that are tolerant of wetness. Grazing when the soil is wet results in surface compaction and poor tilth and damages the pasture plants.

This soil is moderately well suited to trees. The wetness is the main limitation. The trees should be logged when the surface is frozen or during the drier part of the year. Plant competition in the existing stands can be controlled by removing vines and the less desirable trees and shrubs. Frequent, light thinning and harvesting increase the vigor of the stand and reduce the hazard of windthrow. The trees that are tolerant of wetness should be selected for planting.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding and the moderately slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed to allow for good drainage. Enlarging the absorption area and installing perimeter drains can increase the effectiveness of septic tank absorption fields. The perimeter drains help to lower the seasonal high water table.

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

Lf—Lenawee Variant silty clay loam. This deep, nearly level, very poorly drained soil is in broad depressions on lake plains. The lower parts of the depressions are subject to ponding. Most areas are irregularly shaped and are 10 to 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsoil is about 36 inches thick. The upper part is dark gray and gray, mottled, firm silty clay loam and silty clay. The lower part is light gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is gray, mottled, friable silt loam. In a few areas the surface has a residue of burned organic material that appears as reddish brown ash.

Included with this soil in mapping are small areas of Lenawee, Linwood, and Wallkill soils. Lenawee soils are less acid in the subsoil than the Lenawee Variant soil. They are in landscape positions similar to those of the Lenawee Variant soil. The organic Linwood soils are on the lowest part of slight depressions. The alluvial Wallkill soils are adjacent to streams. Included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Lenawee Variant soil. Available water capacity is moderate. The content of organic matter is very high. The potential for frost action is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as habitat for wildlife. A few areas are used as cropland.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to crops and pasture. Seasonal wetness, surface compaction, and acidity are the main management concerns. Surface and subsurface drainage systems help to lower the seasonal high water table, improve aeration, and permit earlier access to the fields in spring. Adequate outlets for subsurface drains are not readily available in some areas. Applying a system of conservation tillage and limiting fieldwork when the soil is wet reduce the hazards of crusting and compaction.

Wetness and surface compaction are management concerns in pastured areas of this soil. The pasture species selected for seeding should be those that are tolerant of wetness. Grazing when the soil is wet results in surface compaction and poor tilth and damages the pasture plants.

This soil is moderately well suited to trees. The wetness is the main limitation. The trees can be logged during the drier parts of the year. Planting seedlings that have been transplanted once can reduce the seedling mortality rate. The hazard of windthrow can be reduced by suitable harvesting techniques.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding and the moderately slow permeability are the main limitations. Properly grading building sites helps to keep water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed to allow for good drainage. Enlarging the absorption area in septic tank absorption fields and using split-flow systems help to overcome the restricted permeability. Installing perimeter drains around the absorption field helps to lower the seasonal high water table.

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

Lm—Linwood muck. This deep, level, very poorly drained, organic soil is in bogs on lake plains. The partially decomposed remains of plants have accumulated over loamy lacustrine deposits in these bogs. The lower parts of the depressions are subject to ponding. Most areas are irregularly shaped and are 20 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is black, very friable muck about 10 inches thick. The next 19 inches is dark reddish brown and very dark grayish brown, friable muck that has some fibers and a few woody fragments. The substratum to a depth of about 60 inches is dark gray and gray, mottled, firm silty clay loam and friable silt loam. In a few areas the organic material is less than 16 inches deep over the mineral material.

Included with this soil in mapping are small areas of Carlisle, Colwood, and Lenawee Variant soils. These soils are in landscape positions similar to those of the Linwood soil. Carlisle soils have more than 51 inches of organic material. Colwood and Lenawee Variant soils do not have organic layers. Also included are some areas along drainage ditches that are covered with mineral material dredged from the ditches. Included soils make up about 10 percent of most areas.

Permeability is moderately slow to moderately rapid in the organic layers of the Linwood soil and moderate or moderately slow in the substratum. Available water capacity is very high. The content of organic matter also is very high. The potential for frost action is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used for vegetable crops. Some areas are used as wildlife habitat.

Celery, radishes, carrots, parsley, and lettuce commonly are grown on this soil. The soil is well suited to crops, especially vegetable crops. The wetness and high acidity are the main limitations in the areas used for vegetable crops. Surface drains and open ditches are used to remove excess water. Annual applications of lime reduce the acidity of the surface layer. Poor air drainage increases the hazard of frost late in spring and early in fall. When the surface dries, the lightweight, friable muck is susceptible to wind erosion. Winter cover crops reduce the hazard of wind erosion.

This soil generally is unsuited to pasture and hay. Because the soil is soft when wet, grazing can cause considerable damage to pasture plants. The wetness and high acidity limit the productivity of most legumes.

This soil generally is unsuited to trees. The wetness is the main limitation. Selecting species that are tolerant of seasonal wetness can reduce the seedling mortality rate. Harvesting procedures that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. Removing vines and the less desirable trees and shrubs can minimize plant competition. The trees should be logged during the drier parts of the year.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields. The ponding, low strength, and subsidence of the organic material are the main limitations.

The land capability classification is IIw. The woodland ordination symbol is 2W.

Ln—Lobdell silt loam, rarely flooded. This deep, nearly level, moderately well drained soil is on high bottoms on flood plains. It is subject to rare flooding of brief duration in fall, winter, and spring. Most areas are irregularly shaped and are 5 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is brown, friable silt loam about 11 inches thick. The subsoil is about 39 inches of yellowish brown, brown, and dark yellowish brown, friable silty clay loam and loam having a thin layer of fine sandy loam. It is mottled in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable sandy loam. In some areas the surface layer is loam. In a few areas the subsoil has more silt and less sand. In places shale fragments are throughout the solum.

Included with this soil in mapping are small areas of Orrville and Tioga soils. The somewhat poorly drained Orrville soils are in depressions and adjacent to uplands. The well drained Tioga soils are in the slightly higher areas. Also included are some areas in closed depressions and old stream channels where water ponds for extended periods and a few areas of soils that are underlain by shale bedrock. Included soils make up about 20 percent of most areas.

Permeability is moderate in the Lobdell soil. Available water capacity is high. The content of organic matter is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. Some areas used as pasture or woodland.

This soil is well suited to row crops and pasture. The hazard of flooding is the main management concern. The soil is best suited to row crops that can be planted after the major threat of flooding in spring. The flooding can damage winter grain crops. Some areas are so dissected by old stream channels that they cannot be easily farmed. Farm equipment cannot easily access some areas because of stream channels and steep valley walls. Subsurface drains can help to remove excess water from the wetter included areas, but drainage outlets are ineffective when the outlet areas are flooded.

Few limitations affect the use of this soil as pasture. Grazing during wet periods can result in surface compaction.

This soil is well suited to trees. Control of plant competition is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

Because of the hazard of flooding and the wetness, this soil generally is unsuitable as a site for buildings and septic tank absorption fields. It is well suited to recreational uses during the drier parts of the year.

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

Lo—Lobdell silt loam, frequently flooded. This deep, nearly level, moderately well drained soil is on flood plains. It is frequently flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and are 5 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is brown and dark brown, friable silt loam about 30 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is light brownish gray, mottled, friable sandy loam and loam.

Included with this soil in mapping are small areas of Orrville and Tioga soils. The somewhat poorly drained

Orrville soils are in depressions and in areas adjacent to upland slopes. The well drained Tioga soils are on slight rises. Also included are some areas in closed depressions and old stream channels where water ponds for extended periods. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Lobdell soil. Available water capacity is high. The content of organic matter is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as pasture or woodland. A few areas are used for row crops.

This soil is moderately well suited to row crops and pasture. The hazard of flooding is the main management concern. The soil is best suited to row crops that can be planted after the major threat of flooding in spring has passed. The flooding can severely damage winter grain crops. Some areas are so dissected by old stream channels that they cannot be easily farmed. Minimizing tillage, incorporating crop residue into the soil, and planting cover crops help to maintain tilth, minimize surface crusting, and protect the surface from scouring during periods of flooding. Grazing during wet periods results in surface compaction.

This soil is well suited to trees. Control of plant competition is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

Because of the frequent flooding and the wetness, this soil generally is unsuitable as a site for buildings and septic tank absorption fields. It is well suited to recreational uses during nearly all periods, except for the brief periods of flooding.

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

LrB—Lordstown loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on bedrock-controlled knolls and slight rises on till plains. Most areas are irregularly shaped and are 20 to 100 acres in size.

Typically, the surface layer is brown, friable loam about 10 inches thick. The subsoil is about 14 inches of dark yellowish brown and yellowish brown, friable fine sandy loam and channery fine sandy loam. Sandstone bedrock is at a depth of about 24 inches. In some areas the subsoil has more clay and less sand. In a few areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Chili, Haskins, and Mitiwanga soils. The deep Chili soils are on some of the highest rises. The somewhat poorly drained Haskins and Mitiwanga soils are on the lower part of the slopes. Also included are a few areas of soils that are shallow over bedrock. These soils are in landscape positions similar to those of the Lordstown soil. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Lordstown soil. Available water capacity is low. The content of organic matter is moderate. The potential for frost action also is moderate. Runoff is medium. The root zone is moderately deep to sandstone bedrock.

Most areas are used as cropland. A few small areas are wooded.

This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Erosion and droughtiness are the main management concerns in the areas used as cropland. Minimizing tillage and leaving crop residue on the surface help to protect the soil from erosion, improve fertility, and increase the rate of water infiltration. Crops can be planted earlier in spring on this soil than on most of the other soils in the county. The good natural drainage allows for early grazing of pastures in spring and favors the establishment of alfalfa.

This soil is moderately well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to buildings without basements and generally is unsuited to buildings with basements and to septic tank absorption fields. The moderate depth to bedrock is the main limitation. The effluent in septic tank absorption fields may not be adequately filtered before moving into fissures in the bedrock. As a result, it can pollute underground water supplies.

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

Mm—Millsdale silty clay loam. This moderately deep, nearly level, very poorly drained soil is on flats and in depressions on lake plains. The lower parts of the depressions are subject to ponding. Most areas are irregularly shaped and are 10 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is black, friable silty clay loam about 11 inches thick. The subsoil is dark gray and gray, mottled, firm silty clay loam about 13 inches thick. Limestone bedrock is at a depth of about 24 inches. In a few areas the subsoil has less clay and more sand. In some areas the depth to bedrock is 40 to 60 inches.

Included with this soil in mapping are small areas of the deep Pewamo soils. These soils are in landscape positions similar to those of the Millsdale soil. Also included are some areas of somewhat poorly drained soils on slight rises and a few areas of soils that have bedrock within a depth of 20 inches. Included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Millsdale soil. Available water capacity is low. The content of organic matter is high. The potential for frost action and the shrink-swell potential also are high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is moderately deep to limestone bedrock.

Most areas are used as cropland. This soil is moderately well suited to crops and is poorly suited to pasture. The wetness and the moderately deep root zone are the main limitations affecting most crops. Surface drains commonly are needed. Subsurface drains also are used, but the bedrock commonly restricts installation. The soil should be tilled only within a limited range in moisture content because it becomes compact and cloddy if it is worked when wet and sticky. Applying a system of conservation tillage that leaves crop residue on the surface, planting cover crops, and incorporating crop residue or other organic material into the surface layer help to maintain tilth, increase the rate of water infiltration, and improve fertility.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Surface compaction, poor tilth, a reduced rate of water infiltration, and retarded plant growth result from overgrazing or grazing when the soil is soft and sticky.

This soil is moderately well suited to trees. The wetness is the main management concern. The trees can be logged during the drier parts of the year. Selecting seedlings that are tolerant of seasonal wetness reduces the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to buildings without basements and generally is unsuited to buildings with basements and to septic tank absorption fields. The ponding, the high shrink-swell potential, and the moderate depth to bedrock are limitations on building sites. Backfilling along foundations with material that has a low shrink-swell potential helps to prevent the structural damage caused by shrinking and swelling. A drainage system is needed. Grading building sites can help to keep water away from foundations. Septic tank absorption fields are ineffective because of the ponding, the moderately slow permeability, and the depth to bedrock.

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

MnB—Milton silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on bedrock-controlled knolls and slight rises on till plains and lake plains. Most areas are oval or irregularly shaped and are 5 to 75 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 19 inches of dark yellowish brown and brown, mottled, firm silty clay loam and clay loam. Limestone bedrock is at a depth of about 27 inches.

Included with this soil in mapping are small areas of soils that have bedrock at a depth of 10 to 20 inches. These soils have more limestone fragments in the surface layer and subsoil than the Milton soil. They are on the upper part of the slopes. Also included are the very poorly drained Millsdale soils in seep areas near the base of the slopes and along drainageways. Included soils make up about 15 percent of most areas.

Permeability is moderate or moderately slow in the Milton soil. Available water capacity is low. The content of organic matter is moderate. The potential for frost action also is moderate. Runoff is medium. The root zone is moderately deep to limestone bedrock.

Most areas are used as cropland. This soil is moderately well suited to row crops, small grain, and hay and is well suited to pasture. Erosion and the low available water capacity are the main limitations affecting most crops. Minimizing tillage and leaving crop residue on the surface help to protect the soil from erosion, improve tillage, and increase the rate of water infiltration. Crops can be planted earlier in spring on this soil than on most of the other soils in the county.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is poorly suited to buildings with basements and is moderately well suited to buildings without basements. It generally is unsuited to septic tank absorption fields. The moderate depth to bedrock and a moderate shrink-swell potential are the main limitations. The soil is better suited to buildings without basements than to buildings with basements. Reinforcing foundations and footings and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. The effluent in septic tank absorption fields may not be adequately filtered before seeping into cracks in the bedrock. As a result, it can pollute underground water supplies.

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

Mr—Miner silty clay loam. This deep, nearly level, very poorly drained soil is in depressions and along drainageways on till plains. The lower parts of the depressions are subject to ponding by runoff from the higher adjacent soils. Most areas are long and narrow or irregularly shaped and are 10 to more than 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 50 inches thick. The upper part is dark gray and gray, mottled, firm silty clay. The lower part is gray, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is brown, firm silty clay loam glacial till. In some areas the surface layer is lighter colored. In a few areas the soil is underlain by stratified lacustrine sediment.

Included with this soil in mapping are small areas of Bennington and Cardington soils. The somewhat poorly drained Bennington soils and the moderately well drained Cardington soils are on the highest part of slight rises. Also included are small, closed depressions that cannot be easily drained and remain ponded for long periods during the growing season. Included soils make up about 10 percent of most areas.

Permeability is slow in the Miner soil. Available water capacity is moderate. The content of organic matter is high. The potential for frost action also is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland. Some areas are used as woodland. A few areas are used as pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to crops and pasture. The wetness and the ponding are the main limitations affecting most crops. Surface and subsurface drains are used to remove excess water. Adequate outlets for subsurface drains are not readily available in some areas. The soil becomes compacted and cloddy if worked when wet. Returning crop residue to the soil and adding other organic material minimize clodding and crusting, improve fertility, and increase the rate of water infiltration.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth.

This soil is moderately well suited to trees. The wetness is the main management concern. Selecting seedlings that are tolerant of seasonal wetness and a high content of clay in the subsoil reduces the seedling mortality rate. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. The trees can be logged during the drier parts of the year.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to allow for good drainage. Enlarging the absorption area, using split-flow systems, and installing perimeter drains can increase the effectiveness of septic tank absorption fields. Adequate drainage outlets are not readily available in some areas.

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

MwB—Mitiwanga silt loam, 1 to 4 percent slopes. This moderately deep, nearly level and gently sloping, somewhat poorly drained soil is on the flat or rounded tops and at the base of bedrock-controlled knolls and summits on till plains. Most areas are narrow and irregularly shaped and are 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is brown, dark yellowish brown, and strong brown, mottled, friable and firm clay loam about 20 inches thick. Sandstone bedrock is at a depth of about 30 inches. In some areas the surface layer and subsoil have more sand.

Included with this soil in mapping are small areas of the well drained Lordstown soils and some areas of moderately well drained soils on slight rises. Also included, on the lower slopes, are some areas of soils that have bedrock at a depth of more than 40 inches. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Mitiwanga soil. Available water capacity is low. The content of organic matter is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. The root zone is moderately deep to sandstone bedrock.

Most areas are used as cropland. A few areas are used as woodland or pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to crops and pasture. Erosion and wetness are the main management concerns in the areas of cropland. Subsurface drains are used to lower the seasonal high water table. Where bedrock is close to the surface, however, installing the drains is difficult. Minimizing tillage and leaving crop residue on the surface help to protect the soil from erosion. Cultivation is difficult in some included areas that are shallow over bedrock and have cobbles on the surface.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Grazing when the soil is wet results in surface compaction and restricts plant growth.

This soil is moderately well suited to trees. Frequent, light thinning can increase the vigor of the stand and reduce the hazard of windthrow.

This soil generally is unsuited to buildings with basements and to septic tank absorption fields. It is moderately well suited to buildings without basements. The depth to bedrock and the wetness are the main limitations on building sites. Drains at the base of footings can help to remove excess water. Properly grading building sites helps to keep water away from foundation walls. Because of the depth to bedrock, a system other than an adsorption field is needed to dispose of effluent.

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

Or—Orrville silt loam, frequently flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. It commonly makes up the entire flood plain along small streams. It is frequently flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and are 10 to 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is yellowish brown, grayish brown, and dark grayish brown, mottled, friable silt loam about 25 inches thick. The substratum to a depth of about 60 inches is grayish brown and dark grayish brown, mottled, friable loam and sandy loam. In some areas it has a higher content of coarse fragments. In a few areas bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Bennington, Holly, and Lobdell soils. Bennington soils have more clay in the subsoil than the Orrville soil. They are in areas that are transitional to the uplands. The poorly drained Holly soils are in the lowest depressions. The moderately well drained Lobdell soils are on slight rises and adjacent to streams. Included soils make up about 10 percent of most areas.

Permeability is moderate in the subsoil of the Orrville soil and moderate or moderately rapid in the substratum. Available water capacity is high. The content of organic matter is moderate. The potential for frost action is high. Runoff is very slow. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. The root zone is deep.

Most areas are used as pasture or woodland. A few small areas are used as cropland.

This soil is moderately well suited to row crops and pasture. The flooding and the wetness are the main limitations in the areas used as cropland. They delay planting in most years and limit the choice of crops. The soil is best suited to row crops that can be planted after the major threat of flooding in spring has passed. Unless flooding is controlled, winter grain commonly is severely damaged. Applying a system of conservation tillage that leaves crop residue on the surface, incorporating crop residue into the surface layer, and planting cover crops help to maintain tilth and prevent crusting. They also help to protect the surface during periods of flooding.

Maintaining tilth and desirable forage stands in pastured areas is difficult unless the soil is drained and grazing is controlled. Overgrazing or grazing during wet periods, when the soil is soft and sticky, results in surface compaction and poor tilth.

This soil is moderately well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the hazard of flooding and the wetness.

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

OsB—Oshtemo fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in undulating areas on beach ridges. Most areas are long and narrow and are 5 to several hundred acres in size.

Typically, the surface layer is brown, friable fine sandy loam about 10 inches thick. The subsoil is brown, dark yellowish brown, and dark brown, very friable gravelly coarse sandy loam about 31 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown, loose very gravelly coarse sand. In a few areas the surface layer is loamy fine sand. In some areas, the solum is thinner and the substratum is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Chili, Elnora, Jimtown, and Spinks soils. Chili soils have more clay in the subsoil than the Oshtemo soil. They are on the lower part of the slopes. The moderately well drained Elnora soils and the somewhat poorly drained Jimtown soils are in the lower, less sloping areas. The sandy Spinks soils are on some of the highest knolls. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the solum of the Oshtemo soil and very rapid in the substratum. Available water capacity is low. The content of organic matter is moderately low. The potential for frost action is moderate. Runoff is slow. The root zone is deep.

Most areas are used as cropland. Some areas are used as pasture or woodland. A few areas are used for orchards or specialty crops.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to crops and well suited to pasture. The main limitations are the susceptibility to wind erosion and droughtiness. The soil dries early in spring and is therefore well suited to early tillage and planting. It is well suited to irrigation. Winter cover crops and no-till farming or another kind of conservation tillage that leaves crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material reduce the hazard of wind erosion and retard surface drying. Because plant nutrients are leached from the soil at a relatively rapid rate, smaller, more frequent and timely applications of fertilizer are needed during the growing season to prevent the loss of amendments. Pastures can be grazed early in spring, when the surrounding areas are still wet. Shallow-rooted plants grow poorly during extended dry periods.

This soil is well suited to trees. Few limitations affect woodland management. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings and is moderately well suited to septic tank absorption fields. Few limitations affect building site development. Properly landscaping building sites helps to direct surface water away from foundation walls. A good plant cover should be maintained on building sites during construction to prevent excessive wind erosion and water erosion. The sides of shallow excavations can cave in. The effluent in septic tank absorption fields drains freely. If it is not adequately filtered, however, it can pollute underground water supplies.

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

OtB—Otisville gravelly sandy loam, 2 to 6 percent slopes. This deep, gently sloping, excessively drained soil is on slight rises on beach ridges. Most areas are long and narrow and are 5 to 50 acres in size.

Typically, the surface layer is dark brown, very friable gravelly sandy loam about 9 inches thick. The subsoil is brown and strong brown, very friable gravelly and very gravelly loamy sand about 27 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, loose gravelly and very gravelly loamy sand. It is mottled in the upper part. In a few areas the subsoil has less sand.

Included with this soil in mapping are some small areas of Fries, Jimtown, Oshtemo, and Prout soils. The poorly drained Fries soils are in the lowest depressions. The somewhat poorly drained Jimtown and Prout soils are in the lower areas at the base of the slopes. Oshtemo soils have fewer coarse fragments in the subsoil than the Otisville soil. They are in landscape positions similar to those of the Otisville soil. Also included are some areas of soils that are underlain by loamy glacial till or lacustrine deposits. Included soils make up about 10 percent of most areas.

Permeability is rapid in the Otisville soil. Available water capacity is very low. The content of organic matter is low or moderately low. The potential for frost action is low. Runoff is slow. The root zone is deep.

Most areas are used as cropland. A few small areas are used as pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay commonly are grown on this soil. The soil is poorly suited to crops and pasture. Droughtiness is the main limitation affecting most crops. The soil is well suited to irrigation. Incorporating crop residue and other organic material into the soil improves the seedbed and the fertility of the soil and increases the available water capacity. Smaller, more frequent and timely applications of lime and fertilizer are needed to minimize the loss of amendments through leaching. Winter wheat and oats grow better than row crops because they mature before the drier part of the growing season. No-till farming or another kind of conservation tillage that leaves crop residue on the surface helps to control erosion. Shallow-rooted plants grow poorly during extended dry periods. Deferment of grazing during dry periods, pasture rotation, selection of suitable species for planting, and weed control help to keep pastures in good condition.

This soil is poorly suited to trees. Because of a high content of sand and gravel and the low available water capacity, establishing seedlings is difficult. Selecting species that are tolerant of dry sites can reduce the seedling mortality rate.

This soil is well suited to buildings and poorly suited to septic tank absorption fields. The sides of shallow excavations can cave in. Erosion is a hazard during construction. Providing less sandy topsoil can improve the suitability for lawns and landscaping and can hasten

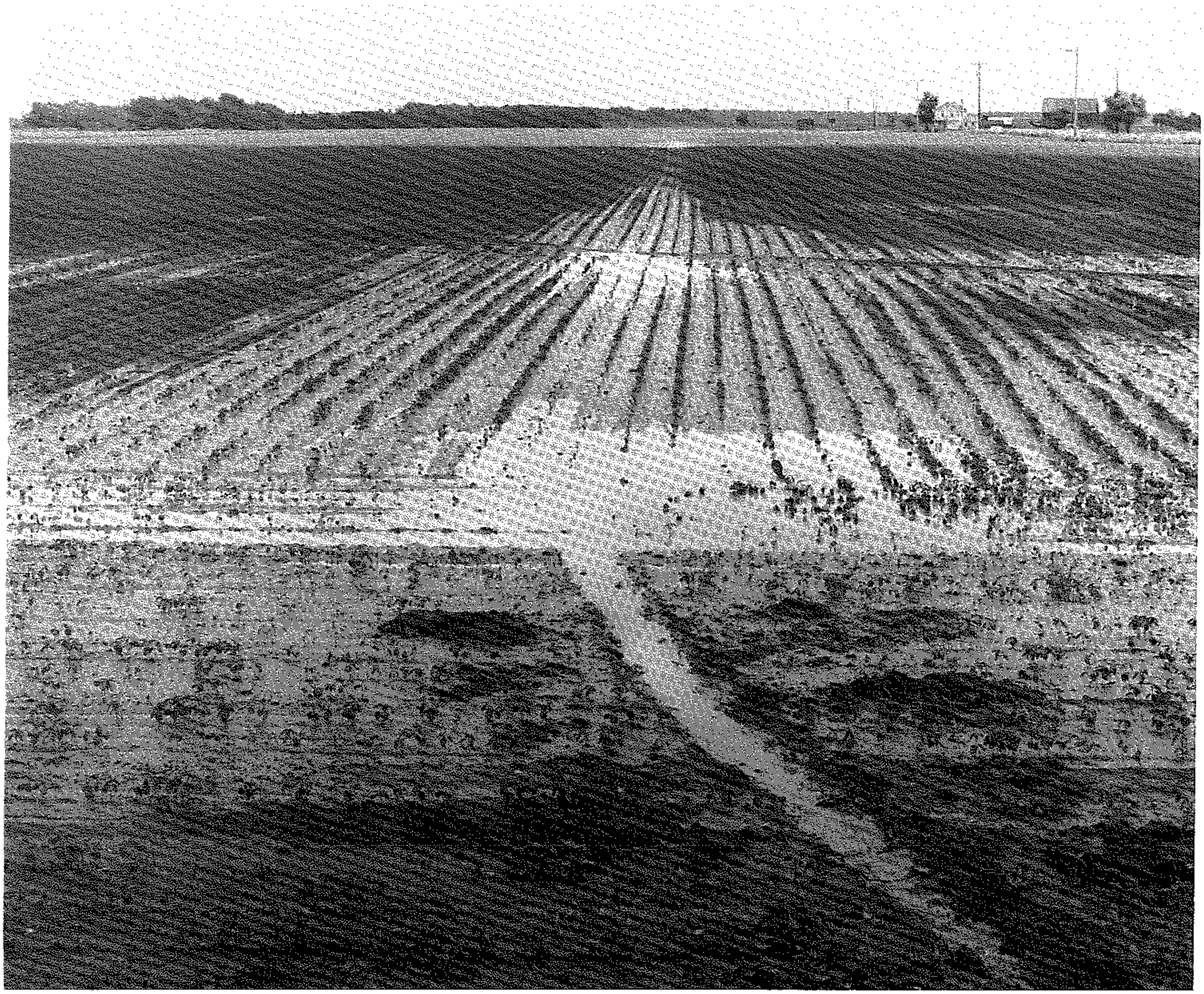

Figure 10.—Ponding in an area of Pandora silty clay loam.

the reestablishment of a plant cover after construction. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The inadequately filtered effluent can contaminate underground water supplies. The included soils that are underlain by loamy material have a better filtering capacity than this soil.

The land capability classification is IVs. The woodland ordination symbol is 3S.

Pa—Pandora silty clay loam. This deep, nearly level, poorly drained soil is in shallow depressions and along drainageways on till plains. The lower parts of the depressions are subject to ponding by runoff from the higher adjacent soils (fig. 10). Most areas are long and narrow or irregularly shaped and are 5 to more than 20 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is about 42 inches thick. The upper part is grayish brown, mottled, firm silty clay loam. The lower part is dark gray and gray, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam. In some areas the soil has a thick, dark surface layer.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils on the highest part of slight rises. Also included are small, closed depressions that cannot be easily drained and a few areas along drainageways where the soil is underlain by shale within a depth of 60 inches. Included soils make up about 15 percent of most areas.

Permeability is slow in the Pandora soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland or woodland. A few areas are used as pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is well suited to row crops and moderately well suited to pasture. The wetness and the ponding are the main limitations affecting most crops. Surface and subsurface drains are used to remove excess water. Adequate outlets for subsurface drains are not readily available in some areas. The soil becomes compacted and cloddy if worked when wet. Returning crop residue to the soil and adding other organic material minimize clodding and crusting, improve fertility, and increase the rate of water infiltration.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth.

This soil is moderately well suited to trees. The wetness is the main management concern. Selecting seedlings that are tolerant of seasonal wetness and a high content of clay in the subsoil reduces the seedling mortality rate. Plant competition can be controlled by removing vines and the less desirable trees and shrubs. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. The trees can be logged during the drier parts of the year.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding and the moderately slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to keep basements dry. Porous backfill material that has a low shrink-swell potential is needed around basement walls to allow for good drainage. Enlarging the absorption area and installing perimeter drains can increase the effectiveness of septic tank absorption fields. Adequate drainage outlets are not readily available in some areas.

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

Pm—Pewamo silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats on lake plains and till plains. The lower areas are subject to ponding. Most areas are irregularly shaped and are 10 to several hundred acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, friable silty clay loam about 12 inches thick. The subsoil is about 47 inches of dark grayish brown and gray, mottled, firm silty clay loam and clay loam. The substratum to a depth of more than 60 inches is brown, mottled, firm clay loam. In some areas the soil has more silt and less clay.

Included with this soil in mapping are small areas of Bennington, Fries, and Millsdale soils. The somewhat poorly drained Bennington soils are on the highest part of slight rises. The moderately deep Fries and Millsdale soils are in landscape positions similar to those of the Pewamo soil. Included soils make up about 10 percent of most areas.

Permeability is moderately slow in the Pewamo soil. Available water capacity and the content of organic matter are high. The potential for frost action also is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few small areas are used as woodland or pasture.

This soil is well suited to corn, soybeans, winter wheat, and hay and is moderately well suited to pasture. Seasonal wetness is the main limitation. Stands of wheat and oats may grow poorly in some years because of local ponding. Surface and subsurface drains commonly are needed to lower the water table. The soil should be tilled only within a limited range in moisture content because it becomes compacted and cloddy if it is worked when wet. Returning crop residue to the soil or adding other organic material improves fertility, minimizes clodding and crusting, and increases the rate of water infiltration.

The hay and pasture plants that are tolerant of wetness grow best on this soil. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth.

This soil is moderately well suited to trees. The wetness is the main management concern. The trees should be harvested during the drier parts of the year. Selecting species that are tolerant of seasonal wetness and a high content of clay in the subsoil can reduce the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding and the moderately slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings can remove excess water. Porous backfill material that has a low shrink-swell potential is needed around basement walls to allow for good drainage. Enlarging the absorption area and installing perimeter drains can increase the effectiveness of septic tank absorption fields.

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

Pn—Pinnebog muck. This deep, level, very poorly drained, organic soil is in bogs on lake plains. Partially decomposed remains of plants have accumulated in these bogs. The lower areas are subject to ponding. The soil occurs as one broad area that is irregularly shaped and about 500 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark reddish brown, very friable muck about 4 inches thick. Below this to a depth of about 60 inches are layers of dark reddish brown, dark brown, and very dark grayish brown, friable muck and mucky peat that have many fibers and a few woody fragments. In some areas the subsurface layer has much less fibrous material.

Included with this soil in mapping are small areas of Lenawee Variant, Linwood, and Wallkill soils. The mineral Lenawee Variant soils are on the periphery of areas that are transitional to mineral soils on uplands. Linwood soils have loamy lacustrine sediment within 51 inches of the surface. They are in landscape positions similar to those of the Pinnebog soil. Wallkill soils have a mineral surface layer and subsoil. They are on the periphery of some areas that are transitional to flood plains. Included soils make up about 10 percent of most areas.

Permeability is moderately slow to moderately rapid in the Pinnebog soil. Available water capacity is very high. The content of organic matter also is very high. The potential for frost action is high. Runoff is very slow or ponded. The seasonal high water table is near or slightly above the surface during extended wet periods. The root zone is deep.

Most areas are used as habitat for upland wildlife and are wooded.

This soil is moderately well suited to vegetable crops. The wetness and high acidity are the main limitations in the areas used for such crops. Surface drains and open ditches are used to remove excess water. Annual applications of lime reduce the acidity of the surface layer. Poor air drainage increases the hazard of frost late in spring and early in fall. When the surface dries, the lightweight, friable muck is susceptible to wind erosion. Winter cover crops reduce the hazard of wind erosion.

This soil generally is unsuited to hay and pasture. Because the soil is soft when wet, grazing can cause considerable damage to pasture plants. The wetness and high acidity limit the productivity of most legumes.

This soil generally is unsuited to trees. The wetness is the main limitation. Selecting species that are tolerant of seasonal wetness can reduce the seedling mortality rate. Harvesting procedures that do not leave the remaining trees widely spaced can reduce the hazard of windthrow. The trees should be logged during the drier parts of the year.

This soil generally is unsuited to building site development and septic tank absorption fields. The ponding, low strength, and subsidence of the organic material are the main limitations.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

Ps—Pits. This map unit consists of areas from which gravel and sand have been excavated or from which rock has been quarried. The areas are on outwash plains, beach ridges, kames, and stream terraces or on bedrock-controlled uplands. They are associated with areas of Spinks, Oshtemo, Chili, Mitiwanga, and Lordstown soils. The pits are irregularly shaped and are 4 to 40 acres in size. Many of the old gravel pits are inactive.

Typically, the slopes are very irregular because of spoil piles, overburden, and mined banks. The side slopes occur as layers of gravel, sand, loamy material, or exposed bedrock. Clay loam glacial till is at the base of some areas. Some areas are barren, and others have been partially filled with water. In most areas the pits are being slowly revegetated by a natural plant succession of weeds, grasses, shrubs, and trees.

Most of the pits have been left idle and are used as habitat for wildlife. The material that remains after mining is poorly suited to plants.

No land capability classification or woodland ordination symbol is assigned.

PuA—Prout silt loam, 0 to 2 percent slopes. This moderately deep, nearly level, somewhat poorly drained soil is on bedrock-controlled rises on till plains and lake plains. Most areas are long and narrow or irregularly shaped and are 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 17 inches thick. The upper part is yellowish brown and light brownish gray, mottled, firm silty clay loam. The lower part is light brownish gray, mottled, firm very shaly silty clay loam. Yellowish brown, rippable, partly weathered shale bedrock is at a depth of about 26 inches. In some areas near beach ridges, the surface layer is sandy loam.

Included with this soil in mapping are small areas of Bennington, Fries, and Pewamo soils. The deep Bennington soils are on the highest part of slight rises. The very poorly drained Fries and Pewamo soils are in the lowest depressions. Included soils make up about 10 percent of most areas.

Permeability is moderately slow in the Prout soil. Available water capacity is low. The content of organic matter is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is perched at a depth of 12 to 30 inches during extended wet periods. The root zone is moderately deep to shale bedrock.

Most areas are used as cropland. A few small areas are used as woodland or pasture.

Corn, soybeans, and winter wheat and grasses and legumes for hay and pasture commonly are grown on this soil. The soil is moderately well suited to row crops, small grain, and hay and pasture. The wetness, the moderately slow permeability, and the moderately deep root zone are the main limitations in the areas used as cropland. Both surface and subsurface drains are used to lower the seasonal high water table. Where bedrock is close to the surface, however, installing subsurface drains is difficult. Outlets for subsurface drains are not available in many areas, and water moves slowly into the drains. Applications of large amounts of lime may be needed to overcome extreme acidity. Minimizing tillage and incorporating crop residue or other organic material into the surface layer improve tilth and fertility, increase the rate of water infiltration, and minimize surface crusting.

This soil is poorly suited to grazing during extended wet periods. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth. The hay and pasture plants that are tolerant of wetness grow best.

This soil is poorly suited to trees. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Control of competing vegetation is a management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil generally is unsuited to buildings with basements and to septic tank absorption fields. It is moderately well suited to buildings without basements. The wetness and the depth to shale bedrock are the main limitations. Drains at the base of footings can help to remove excess water. Properly grading building sites helps to keep water away from foundation walls. Because of the limited depth to bedrock, a system other than an adsorption field is needed to dispose of effluent.

The land capability classification is IIIw. The woodland ordination symbol is 3D.

SaF—Saylesville silt loam, 25 to 40 percent slopes. This deep, very steep, well drained soil is along streams and drainageways on lake plains. Most areas are 10 to 100 acres in size and are long and narrow.

Typically, the surface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil is brown and dark yellowish brown, friable and firm silty clay loam about 30 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown and brown, firm, stratified silty clay loam and silt loam. In some areas the soil is eroded and has a surface layer of silty clay loam and a thinner subsoil. In other areas the subsoil has less clay and more silt.

Included with this soil in mapping are small areas of the moderately deep Brecksville soils on some of the steepest parts of the slopes. Also included are some areas of soils that contain less clay and more sand and gravel in the subsoil than the Saylesville soil and are on the upper part of most slopes and some areas of moderately steep soils. Included soils make up about 10 percent of most areas.

Permeability is moderately slow in the Saylesville soil. Available water capacity is high. The content of organic matter is moderate. The potential for frost action also is moderate. Runoff is very rapid. The root zone is deep.

Most areas are used as pasture or woodland. This soil generally is unsuited to row crops, small grain, hay, and pasture because of the slope. If the soil is used as pasture, the slope, the hazard of erosion, surface compaction, and the level of fertility are the main management concerns. The slope limits the operation of equipment used in seeding and in applying fertilizer. Restricted grazing when the soil is wet minimizes surface compaction and erosion. Grasses do not grow well during dry periods in summer.

This soil is moderately well suited to trees. The slope is the main management concern. Building logging roads and skid trails on the contour facilitates the use of equipment and helps to control erosion. Water bars and a plant cover also help to control erosion. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

Because of the slope and the moderately slow permeability, this soil generally is unsuited to building site development and septic tank absorption fields. It generally is unsuited to recreational uses because of the slope.

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

ScB—Shinrock silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on slight rises and knolls on lake plains. Most areas are irregularly shaped and are 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is yellowish brown, brown, and dark yellowish brown, mottled, friable and firm silty clay loam about 26 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown and brown, mottled, firm silty clay loam that has thin strata of silt loam. In a few areas the soil is underlain by glacial till.

Included with this soil in mapping are small areas of Bennington, Lenawee, and Tuscola soils. The somewhat poorly drained Bennington soils are in the lower areas at the base of the slopes. The very poorly drained Lenawee soils are in the lowest areas along drainageways. Tuscola soils have less clay in the subsoil than the Shinrock soil. They are on the highest knolls and rises. Included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Shinrock soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is medium. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few areas are used as woodland or pasture.

This soil is well suited to corn, soybeans, and small grain and is moderately well suited to hay and pasture. Erosion is the main management concern. No-till farming or another kind of conservation tillage that leaves crop residue on the surface helps to control erosion and increases the rate of water infiltration. Grassed waterways protect the surface from concentrated runoff and help to control erosion. Including close-growing crops in the cropping system also helps to control erosion. Returning crop residue to the soil or adding other organic material minimizes surface crusting and improves tilth and fertility. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction. Random surface drains are needed in areas of the wetter included soils. Pasture rotation, proper stocking rates, and deferred grazing during extended wet periods help to keep pastures in good condition.

This soil is well suited to trees. A high content of clay in the subsoil is the main management concern. Using planting techniques that spread the roots of seedlings and improve the soil-to-root contact can reduce the seedling mortality rate. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow.

This soil is well suited to buildings without basements, moderately well suited to buildings with basements, and poorly suited to septic tank absorption fields. The seasonal wetness, the moderately slow permeability, and a moderate shrink-swell potential are the main limitations. Erosion is a hazard during construction. Stockpiling material from the surface layer and then spreading it during final grading hastens the reestablishment of a plant cover. Properly grading building sites helps to keep surface water away from foundation walls and septic tank absorption fields. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundation walls to allow for good drainage. Strengthening foundation walls and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Installing perimeter drains, enlarging the absorption area, and using split-flow systems can increase the effectiveness of septic tank absorption fields. The sides of shallow excavations can cave in.

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

SpB—Spinks loamy fine sand, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on rises on beach ridges. Most areas are long and narrow and are 10 to more than 200 acres in size.

Typically, the surface layer is brown, loose loamy fine sand about 12 inches thick. Below this to a depth of about 60 inches is yellowish brown, loose loamy fine sand that has bands of dark brown, very friable loamy fine sand. In some areas the soil has fewer bands.

Included with this soil in mapping are small areas of Chili, Elnora, and Oshtemo soils. Chili and Oshtemo soils are in landscape positions similar to those of the Spinks soil. They have less sand and more silt and clay than the Spinks soil. The moderately well drained

Elnora soils are on the lowest part of the slopes. Included soils make up about 10 percent of most areas.

Permeability is moderately rapid in the Spinks soil. Available water capacity is low. The content of organic matter is moderate. The potential for frost action is low. Runoff is slow. The root zone is deep.

Most areas are used as cropland. Many areas are used as building sites.

This soil is moderately well suited to corn, soybeans, and winter wheat and is well suited to grasses and legumes for hay and pasture. It is suited to irrigated specialty crops. Droughtiness, the sandy surface layer, and erosion are the main management concerns. Crops can be planted earlier in spring on this soil than on most of the other soils in the county. Because applied nutrients are rapidly leached from the soil, frequent applications of smaller amounts of lime and fertilizer are more effective than one large application. Wind erosion and water erosion are hazards. Crop residue management and cover crops help to maintain the content of organic matter, conserve moisture, and help to prevent excessive soil loss.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing plants is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. The effluent in septic tank absorption fields drains freely. If it is not adequately filtered, however, it can pollute underground water supplies. Central sewage systems can be used, or alternative sewage treatment and disposal systems can be installed. The sides of shallow excavations can cave in. Maintaining as much vegetation as possible on the site during construction helps to control water erosion and wind erosion. If seeded during dry periods, lawns should be mulched and watered.

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

Tg—Tioga loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along the major streams. It is occasionally flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and are 20 to more than 500 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is brown, friable loam about 11 inches thick. The subsoil is dark yellowish brown, friable loam about 9 inches thick. The substratum to a depth of about 60 inches is brown, very friable and loose fine sandy loam, loam, loamy sand, and sandy loam. It is mottled in the lower part. In some areas the subsoil has less sand and more clay.

Included with this soil in mapping are small areas of Lobdell and Orrville soils. The moderately well drained Lobdell soils and the somewhat poorly drained Orrville soils are in the lower areas adjacent to the uplands. Also included are small areas of frequently flooded soils on the lower parts of the landscape and a few small areas of soils that are adjacent to bedrock outcrops and have a surface layer of shaly loam. Included soils make up about 20 percent of most areas.

Permeability is moderate or moderately rapid in the solum of the Tioga soil and moderate to rapid in the substratum. Available water capacity and the content of organic matter are moderate. The potential for frost action also is moderate. Runoff is slow. The seasonal high water table is at a depth of 36 to 72 inches during extended wet periods. The root zone is deep.

Most areas are used as woodland. A few small areas are used as cropland.

This soil is moderately well suited to row crops and small grain and is well suited to hay and pasture. The occasional flooding is the main hazard affecting most crops. In most years row crops can be planted and harvested during periods when flooding does not occur. Winter grain can be damaged by floodwater. Dikes can be used to control flooding. Applying a system of conservation tillage that leaves crop residue on the surface and planting cover crops help to protect the surface from scouring during periods of flooding.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing plants is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the occasional flooding and the wetness. A poor filtering capacity is an additional limitation on sites for septic tank absorption fields.

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

TrA—Tiro silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on extensive flats and slight rises on water-modified till plains. Most areas are 10 to more than 200 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 30 inches thick. The upper part is yellowish brown and brown, mottled, friable silt loam and firm silty clay loam. The lower part is brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam glacial till. In a few areas the subsoil has more clay.

Included with this soil in mapping are small areas of Cardington, Condit, and Haskins soils. The moderately well drained Cardington soils are on the highest part of low knolls. The poorly drained Condit soils are on the lowest part of depressions and along drainageways. Haskins soils have more sand and less silt in the subsoil than the Tiro soil. They are in landscape positions similar to those of the Tiro soil. Included soils make up less than 15 percent of most areas.

Permeability is slow or moderately slow in the Tiro soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is perched at a depth of 12 to 30 inches during extended wet periods. The rooting depth is restricted mainly to the 30- to 40-inch zone above compact glacial till.

Most areas are used as cropland. A few small areas are used as woodland or pasture.

This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Seasonal wetness is the main management concern. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. No-till farming or another kind 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 surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels reduce the hazard of surface compaction.

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

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is moderately well suited to buildings and is poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The limitations affecting septic tank absorption fields can be partially overcome by increasing the size of the absorption area and by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods.

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

TrB—Tiro silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on water-modified till plains. It generally is on low knolls and ridges or on slightly dissected slopes at the head of minor drainageways. Most areas are 5 to 30 acres in size and are long and narrow.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 30 inches thick. The upper part is yellowish brown and dark yellowish brown, mottled, firm silty clay loam. The lower part is dark yellowish brown and brown, mottled, friable loam and firm silty clay loam. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam glacial till. In a few areas the lower part of the subsoil has more clay. In some areas the surface layer is silty clay loam and is moderately eroded.

Included with this soil in mapping are small areas of Cardington, Condit, and Haskins soils. The moderately well drained Cardington soils are on the crest of knolls or in the most sloping areas. The poorly drained Condit soils are in the lowest positions along drainageways and in depressions. Haskins soils have more sand and less silt in the subsoil than the Tiro soil. They are in landscape positions similar to those of the Tiro soil. Included soils make up less than 15 percent of most areas.

Permeability is slow or moderately slow in the Tiro soil. Available water capacity is moderate. The content of organic matter also is moderate. The potential for frost action is high. Runoff is medium. The seasonal high water table is perched at a depth of 12 to 30 inches during extended wet periods. The rooting depth is restricted mainly to the 30- to 40-inch zone above compact glacial till.

Most areas are used as cropland. A few areas are used as woodland.

This soil is well suited to corn, soybeans, and winter wheat and to grasses and legumes for hay and pasture. Erosion and seasonal wetness are the main management concerns. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. No-till farming or another kind 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 removing surface runoff and in reducing the hazard of 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 reduce the hazard of surface compaction.

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

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements, moderately well suited to buildings with basements, and poorly suited to septic tank absorption fields. The wetness and the slow permeability are the main limitations. Erosion is a hazard during construction. Stockpiling material from the surface layer and then spreading it during final grading hasten the reestablishment of a plant cover. Properly grading building sites helps to keep surface water away from foundation walls. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Porous backfill material is needed around foundations to allow for good drainage. The limitations affecting septic tank absorption fields can be partially overcome by increasing the size of the absorption area and by using split-flow systems. Perimeter drains help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods.

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

TuA—Tuscola fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on flats on lake plains and outwash plains. Most areas are irregularly shaped and are 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, friable fine sandy loam about 10 inches thick. The subsoil is about 31 inches of yellowish brown and brown, friable sandy loam and loam. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown, mottled, friable silt loam stratified with loamy fine sand. In some areas the surface layer is very dark grayish brown. In other areas coarse fragments are throughout the soil. In a few places the subsoil contains less clay.

Included with this soil in mapping are small areas of Colwood, Elnora, and Saylesville soils. The very poorly drained Colwood soils are on the lowest part of depressions and along drainageways. Elnora soils contain more sand than the Tuscola soil. They are on the highest part of slight rises. Saylesville soils are well drained and are in dissected areas along drainageways. They contain more clay in the subsoil than the Tuscola soil. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Tuscola soil. Available water capacity is high. The content of organic matter is moderate. The potential for frost action is high. Runoff is slow. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few areas are used as woodland or pasture.

Corn, soybeans, and winter wheat commonly are grown on this soil. The soil is well suited to crops and pasture. The wetness and the hazard of wind erosion are the main management concerns. Random subsurface drains are needed in areas of the wetter included soils, but suitable drainage outlets are not available in some areas. The soil can be easily tilled throughout a wide range in moisture content. Incorporating crop residue or other organic material into the surface layer increases the rate of water infiltration, improves tilth and fertility, helps to control wind erosion, and improves the soil-to-seed contact.

This soil can be used as pasture during much of the growing season. Selection of suitable species for planting, pasture rotation, weed control, and proper stocking rates help to keep the pasture in good condition.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements, moderately well suited to buildings with basements, and poorly suited to septic tank absorption fields. The wetness and a moderate shrink-swell potential are the main limitations. Because of the seasonal wetness, the soil is better suited to buildings without basements than to buildings with basements. Grading building sites helps to keep surface water away from foundations. Foundation drains and protective coatings on the exterior of basement walls help to keep basements dry. Backfilling foundation walls with material that has a low shrink-swell potential helps to prevent the structural damage caused by shrinking and swelling. Perimeter drains around septic tank absorption fields help to lower the seasonal high water table. Some type of filtering material can be used to keep sand from filling subsurface drains. The sides of shallow excavations can cave in, especially when the soil is wet.

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

TuB—Tuscola fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on slight rises and in slightly dissected areas on lake plains and outwash plains. Most areas are irregularly shaped and are 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, friable fine sandy loam about 7 inches thick. The subsoil is about 28 inches of yellowish brown, dark yellowish brown, and grayish brown, mottled, friable loam, fine sandy loam, and silt loam. The substratum to a depth of about 60 inches is dark grayish brown and brown, mottled, friable fine sandy loam. In some areas coarse fragments are throughout the soil. In a few places the subsoil contains less clay.

Included with this soil in mapping are small areas of Elnora, Kibbie, and Saylesville soils. The somewhat poorly drained Kibbie soils are on nearly level flats and along drainageways. Elnora soils contain more sand than the Tuscola soil. They are in the highest areas. Saylesville soils are well drained and are in dissected areas along drainageways. They contain more clay in the subsoil than the Tuscola soil. Included soils make up about 15 percent of most areas.

Permeability is moderate in the Tuscola soil. Available water capacity is high. The content of organic matter is moderately low. The potential for frost action is high. Runoff is medium. The seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. The root zone is deep.

Most areas are used as cropland. A few areas are used as pasture or woodland.

Corn, soybeans, and winter wheat commonly are grown on this soil. The soil is well suited to crops and pasture. Water erosion and wind erosion are the main management concerns. The soil can be easily tilled throughout a wide range in moisture content. Incorporating crop residue or other organic material into the surface layer increases the rate of water infiltration, improves tilth and fertility, helps to prevent excessive soil loss, and improves the soil-to-seed contact.

This soil can be used as pasture during much of the growing season. Selection of suitable species for planting, pasture rotation, weed control, and proper stocking rates help to keep the pasture in good condition.

This soil is well suited to trees. Few limitations affect woodland management. Control of competing vegetation is the main management concern. Removing vines and the less desirable trees and shrubs can minimize plant competition.

This soil is well suited to buildings without basements, moderately well suited to buildings with basements, and poorly suited to septic tank absorption fields. The wetness and a moderate shrink-swell potential are the main limitations. Because of the seasonal wetness, the soil is better suited to buildings without basements than to buildings with basements. Grading building sites helps to keep surface water away from foundations. Foundation drains and protective coatings on the exterior of basement walls help to keep basements dry. Backfilling foundation walls with material that has a low shrink-swell potential helps to prevent the structural damage caused by shrinking and swelling. Perimeter drains around septic tank absorption fields help to lower the seasonal high water table. Some type of filtering material can be used to keep sand from filling subsurface drains. The sides of shallow excavations can cave in, especially when the soil is wet.

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

Ud—Udorthents, loamy. These deep, nearly level and gently sloping, loamy soils are in areas where the landscape has been extensively altered by construction activities. They are on rises and flats. Some areas have been used as a source of borrow material. In a few areas the soils have been used as sites for landfills. Areas are 5 to 100 acres in size. Slope is 0 to 6 percent.

Typically, the upper 60 inches of these soils is silt loam or silty clay loam. It is a mixture of material from the subsoil and substratum of natural soils. In some places much of the surface layer, subsoil, or substratum has been removed. In other places soil material has been added. Much of the original surface has been graded. The mixture of soil material varies so considerably that it cannot be classified at the series level.

Included with these soils in mapping are some areas of soils in depressions and at the base of the slopes. These included soils are wetter than the Udorthents. Also included, on the more sloping parts of the landscape, are some areas where soil material has been piled or where cutbanks from excavations remain.

Permeability varies in the Udorthents, but it generally is moderately slow or slow. Available water capacity varies. The content of organic matter generally is very low. Runoff is dominantly medium or rapid. In many areas the soils are calcareous to the surface.

Most of the acreage is idle land that has only a sparse cover of vegetation. Tilth generally is poor. Erosion is a severe hazard. Controlling erosion, improving fertility, and selecting suitable plant species are the main management concerns. The surface layer crusts during hard rains. The crusting reduces the rate of water infiltration. After drying, the crust may be so restrictive that the emergence and growth of seedlings are severely retarded or stopped. Seeding these areas to adapted species of grasses and legumes that quickly provide ground cover reduces the hazard of erosion. Stands of grasses or legumes can be improved by mulching and applying fertilizer. The seedbed and root zone can be improved by blanketing the area with topsoil.

The suitability of these soils for building site development and septic tank adsorption fields varies from site to site. Restricted permeability is a limitation. Onsite investigation is needed to determine the suitability for any proposed use.

No land capability classification or woodland ordination symbol is assigned.

Wa—Wallkill silt loam, lacustrine substratum, occasionally flooded. This deep, nearly level, very poorly drained soil is in depressions on flood plains and around the margin of organic soils adjacent to uplands. It is occasionally flooded for brief periods in fall, winter, and spring. Most areas are irregularly shaped and are 20 to 75 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, friable, silt loam about 12 inches thick. The subsoil is dark grayish brown, mottled, friable silt loam about 17 inches thick. The next 20 inches is black, friable muck. The substratum to a depth of about 60 inches is dark gray, mottled, friable silty clay loam stratified with thin layers of silt loam. In some small areas the upper mineral material is less than 16 inches thick.

Included with this soil in mapping are small areas of Lenawee Variant and Linwood soils. These soils are in landscape positions similar to those of the Wallkill soil. Lenawee Variant soils do not have organic layers. Linwood soils have an organic surface layer. Included soils make up about 10 percent of most areas.

Permeability is moderate in the mineral upper part of the Wallkill soil, moderately rapid in the organic part, and slow or moderately slow in the lower lacustrine material. Available water capacity is high. The content of organic matter is moderate. The potential for frost action is high. Runoff is very slow or ponded. The water table is at or near the surface during extended wet periods. The root zone is deep.

Most areas are used as cropland. This soil is moderately well suited to corn, soybeans, and specialty crops. Flooding and seasonal wetness are the main limitations. Levees have been constructed in some areas to control the flooding. Surface and subsurface drains are effective in lowering the water table if suitable drainage outlets can be obtained. Deepening stream channels helps to provide drainage outlets.

This soil is poorly suited to pasture. Grazing when the soil is wet results in surface compaction and poor tilth, reduces the rate of water infiltration, and restricts plant growth. The hay and pasture plants that are tolerant of wetness should be selected for planting.

This soil is moderately well suited to trees. The wetness is the main management concern. Frequent, light thinning and harvesting can increase the vigor of the stand and reduce the hazard of windthrow. Selecting seedlings that are tolerant of wetness can reduce the seedling mortality rate. Removing vines and the less desirable trees and shrubs can minimize plant competition. The trees should be logged during the drier parts of the year.

Because of the flooding, the wetness, the slow or moderately slow permeability, and low strength in the organic material, this soil generally is unsuitable as a site for buildings and septic tank absorption fields. It is well suited to habitat for wetland wildlife.

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

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 or 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 expenditure 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 297,600 acres in the survey area, or nearly 94 percent of the total acreage, meets the soil requirements for prime farmland. Most of the acreage of this land is used for corn or soybeans.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to other uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, are droughty, are 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 and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have 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 and management to the limitations and potentials of natural resources and the environment. Also, it can help to prevent 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 behavioral 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 recreational 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 this 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 under the heading "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

Edwin H. McConoughey and Michael D. Patterson, soil conservationists, helped prepare this section.

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

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

In 1985, about 191,000 acres in the county was used for crops or pasture. Of this total, 150,600 acres was used for row crops, mainly corn and soybeans; 27,100 acres for close-grown crops, mainly wheat and oats; 4,700 acres for specialty crops; and 8,600 acres for hay.

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

Cropland Management

The major management concerns on the cropland in the county are wetness, water erosion, wind erosion, fertility, and tilth. These concerns are described in the following paragraphs.

Because of wetness, soil drainage is the major management concern on about 60 percent of the acreage in the county. Some of the soils are naturally so wet that the production of the crops commonly grown in the county generally is not feasible unless a drainage system is installed. Examples are the very poorly drained Carlisle, Colwood, Fries, Lenawee, Lenawee Variant, Linwood, Millsdale, Miner, Pewamo, Pinnebog, and Wallkill soils, which make up about 10 percent of the county.

Unless drained, the somewhat poorly drained soils are so wet that crops are damaged in most years and planting or harvesting is delayed. Examples are Bennington, Bixler, Blount, Haskins, Jimtown, Kibbie, Mitiwanga, Orrville, Prout, and Tiro soils, which make up about 47 percent of the county. In some soils filtering material is needed to keep subsurface drain lines from filling with silt and very fine sand. Examples are Bixler, Kibbie, and Tuscola soils.

In many areas of the moderately well drained Cardington, Glynwood, Elnora, Lobdell, Shinrock, and Tuscola soils, wetter soils are included in depressions and pockets along drainageways and in swales. A drainage system is needed in some of these areas to optimize management for crop production.

The design of both surface and subsurface drainage systems varies with the surface and internal properties of the soils, the position on the landscape, and the depth to bedrock. A combination of surface and subsurface drains is needed in most areas of the very poorly drained and poorly drained soils that are intensively row cropped. Drains should be more closely spaced in slowly permeable or very slowly permeable soils than in more permeable soils. Subsurface drainage is slow or very slow in Condit, Fries, and Miner soils. Open ditches commonly are used to remove surface water and to serve as outlets for subsurface drains. Locating good outlets for subsurface drains is difficult on the broad flats on upland lake plains and till plains, especially in depressions.

Organic soils oxidize and subside when their pore space is filled with air. Special drainage systems are needed to control the depth and period of drainage in these soils. During the cropping season, the water table should be lowered to a level that allows good aeration of the root zone but still meets the needs of the plants for water. Raising the water table to the surface during the rest of the year minimizes oxidation and subsidence.

Water erosion is a problem on about 37 percent of the acreage in the county (fig. 11). It is a hazard in areas where the slope is more than 2 percent. Bennington, Blount, Brecksville, Cardington, Chili, Lordstown, Glynwood, Milton, Mitiwanga, Oshtemo, Tiro, Tuscola, Saylesville, and Shinrock soils are examples of soils that have a slope of more than 2 percent. Alexandria, Cardington, and Glynwood soils have lost much of their original friable surface layer as a result of erosion. Preparing a good seedbed and tilling are difficult on these eroded soils. Eroded spots are included in areas of many of the other soils in the county.

Loss of the surface layer through erosion reduces productivity and results in the sedimentation of streams and deterioration of tilth. Productivity is reduced as the surface layer is lost and the upper part of the subsoil is incorporated into the plow layer. Erosion especially reduces the productivity of soils that tend to be droughty, such as Oshtemo and Spinks soils. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods can reduce soil losses to an amount that will not reduce the productive capacity of the soil. Including grasses and legumes in the cropping system reduces the risk of erosion, increases the supply of nitrogen, and improves tilth.

The slopes are so short and irregular that farming on the contour is not practical in areas of the gently sloping Bennington, Blount, Cardington, Castalia, Chili, Glynwood, Lordstown, Milton, Mitiwanga, Oshtemo, Otisville, Shinrock, Spinks, Tiro, and Tuscola soils. Unless tillage is kept to a minimum on these soils, a cropping system that provides a substantial plant cover is needed to control erosion.

Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. These measures can be applied on most of the soils in the county. No-till farming is effective in reducing the hazard of erosion on sloping soils. Ridge planting is suitable on the very poorly drained soils in the county.

Diversions can control runoff and erosion on long slopes. They are most practical on soils that have smooth slopes. Most of the soils in the county are not well suited to terracing because of irregular slopes, a clayey subsoil, or bedrock at a depth of 20 to 40 inches.

Grassed waterways are natural or constructed outlets that are protected by a plant cover. Natural drainageways are the best sites for grassed waterways. They commonly require a minimal amount of shaping. They should be wide and flat, so that farm machinery can cross them easily.

Water and sediment control basins can be used in place of grassed waterways on small watersheds. These basins are earth embankments that generally are constructed across the slope of minor watercourses. The basins trap sediment and reduce the hazard of gully erosion.

Wind erosion is a hazard on Bixler, Carlisle, Elnora, Kibbie, Linwood, Oshtemo, Pinnebog, Spinks, and Tuscola soils. This hazard can be reduced by maintaining a plant cover, a surface mulch, or a rough

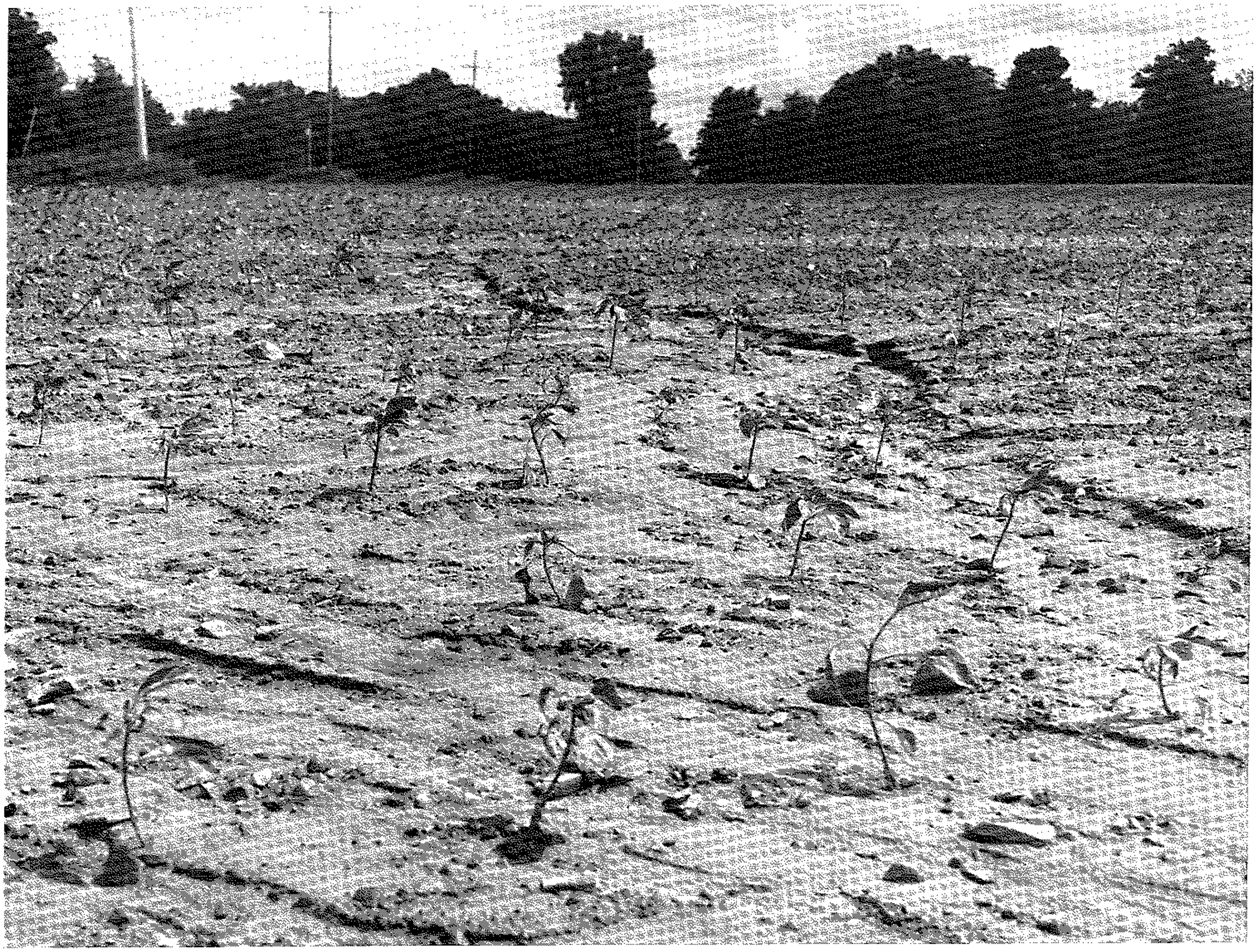

Figure 11.—Erosion in a clean-tilled area of Jimtown loam, 0 to 3 percent slopes.

surface through proper tillage. It also can be reduced by cover crops, by strips of sod in areas used for row crops, and by field windbreaks.

Specific information about the design of measures that control wind erosion and water erosion can be obtained from the office of the soil and water conservation district.

Natural fertility is low in some of the sandy soils in the county, such as Elnora and Spinks soils. It commonly is high in the soils on lake plains, such as Colwood, Lenawee, and Pewamo soils. Applications of lime are needed to raise the pH of acid soils. Unless they have been limed, the organic Carlisle, Linwood, and Pinnebog soils commonly are medium acid to very strongly acid. These soils require special fertilizer because they are low in content of boron and other trace elements.

On all soils additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. A wide variation in soil reaction is possible within short distances. To be most effective, soil sampling for testing should be done according to the kind of soil within each field. The Ohio Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are friable and porous.

In most of the soils that are used for crops in the county, the surface layer is loam, silt loam, fine sandy loam, or silty clay loam and has a high to moderately low content of organic matter. Generally, the structure of these soils is moderate or weak. During periods of intensive rainfall, a crust can form on the soils that have a surface layer of silt loam, loam, or silty clay loam. The crust commonly is hard when dry and is nearly impervious to water. It reduces the rate of water infiltration and increases the rate of runoff. Regular additions of crop residue, manure, and other organic material improve soil structure and reduce the susceptibility to crusting.

Fall plowing is not a good management practice on Alexandria, Bennington, Bixler, Blount, Cardington, Carlisle, Castalia, Chili, Elnora, Glynwood, Linwood, Lordstown, Milton, Mitiwanga, Oshtemo, Otisville, Pinnebog, Shinrock, Spinks, Tiro, and Tuscola soils. The exposed surface of these soils is susceptible to water erosion and wind erosion. A winter cover crop helps to control wind erosion. All sloping soils and some nearly level, light colored soils are susceptible to water erosion and wind erosion if they are plowed in fall.

The dark surface layer in Fries, Lenawee, Lenawee Variant, Millsdale, and Pewamo soils contains more clay than the surface layer in most of the lighter colored soils. Because the darker soils often stay wet until late in spring, maintaining good tilth is difficult. If plowed when wet, these soils tend to become cloddy as they dry. As a result, preparing a good seedbed is difficult. Plowing these dark soils in fall generally results in better tilth in spring.

Pasture Management

Pasture makes up only about 2 percent of the land in the county *(21)*. Some permanent pastures are in areas of eroded soils that formerly were cultivated. Some pastures also are in narrow strips and in irregularly shaped areas on flood plains. If used as pasture, open woodlots generally provide grazing of poor quality because they produce only sparse stands of forage plants. Many permanent pastures near farmsteads are used as feedlots or access lanes.

Most of the soils in the county can be used for high-quality permanent pasture. Pasture plants grow well on Alexandria, Cardington, Chili, Glynwood, Shinrock, and Tuscola soils. These soils are subject to erosion if the protective plant cover is overgrazed. If livestock are allowed to trample these soils during wet periods, surface compaction is severe.

The Lobdell and Orrville soils on flood plains are suited to permanent pasture because they are fertile and have a high available water capacity. Flooding during the growing season damages grain crops, but it is less detrimental to permanent pasture. Surface and subsurface drains are needed to remove excess water in areas of the somewhat poorly drained or poorly drained Blount, Bennington, and Condit soils.

Good management is needed if permanent pasture is to be highly productive. Lime and fertilizer should be applied at rates indicated by soil tests. Weeds can be controlled by periodic clipping and by applying recommended herbicides. Proper seeding rates and controlled grazing help to keep well established permanent pastures in good condition. Specific information about seeding mixtures, herbicide treatment, and other management practices for individual soils can be obtained from the local office of the Ohio Cooperative Extension Service or the Soil Conservation Service.

Specialty Crops

Vegetable and orchard crops are the most important specialty crops grown in the county. A high level of management is needed if these crops are to be grown successfully. The costs of growing specialty crops commonly are higher than the costs of growing general crops. Information about specific management practices, fertilization rates, and seeding varieties can be obtained from the local office of the Ohio Cooperative Extension Service or the Soil Conservation Service.

Such vegetables as lettuce, broccoli, radishes, celery, onions, and potatoes are the main crops grown on the organic soils in the county, including Carlisle and Linwood soils. These soils warm up slowly in spring, are subject to ponding, and generally require liberal applications of potash fertilizer and lime. Drainage is a very important management concern in the areas used for specialty crops. Wind erosion also is a management concern on mucky soils. It can be controlled by cover crops, irrigation, and windbreaks.

Apples and peaches are the major orchard crops in the county. Most of the orchards are on high, sloping beach ridges and kames characterized by good soil and air drainage. Many of the well drained and moderately well drained soils, such as Chili, Oshtemo, Spinks, Elnora, Alexandria, and Cardington soils, are suitable for orchards.

Irrigation

Rainfall in Huron County generally is adequate for most crops, but it is not always timely or well distributed throughout the growing season. Extended dry periods sometimes occur between June and September.

Some of the soils in the county can be irrigated if irrigation water is available. The features that affect the suitability of a soil for irrigation are the available water capacity, the slope, the rate of water infiltration, the need for drainage, the depth of the root zone, the susceptibility to flooding, the hazard of erosion, and layers that restrict water movement and root development. Soils that have a slope of more than 6 percent are highly erodible if irrigated. The soils in the county that are best suited to irrigation are the well drained and moderately well drained, sandy and loamy soils that have a slope of less than 6 percent. Examples are the nearly level or gently sloping Chili, Elnora, Oshtemo, Otisville, Spinks, and Tuscola soils.

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 Ohio 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 *(19)*. 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 degrees of 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 hazard is the 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 under the heading "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Jack Basinger, forester, Ohio Department of Natural Resources, Division of Forestry, helped prepare this section.

Nearly all of Huron County was covered with northern hardwoods when the early settlers arrived. As a result of clearing, the acreage of woodland has been reduced to about 49,900 acres, or less than 16 percent of the total acreage in the county *(21)*. The woodland occurs mainly as scattered areas that were never cleared and converted to cropland. The timber in these areas has been harvested several times, and most of the areas were pastured prior to 1950. The present condition and composition of the woodland are largely determined by the kind of soil and by the cutting and management practices that were used in the past. Most of the native tree species reach their optimum growth potential on the forested soils in the county.

The woodland in areas of the very poorly drained and poorly drained soils in the county generally supports species that are tolerant of wet sites, such as red maple, silver maple, soft maple, swamp white oak, pin oak, bur oak, and ash. The wettest sites in areas of the very poorly drained soils, where water stands during part of the year, support soft maple. The better drained soils support a wider variety of trees, the most common of which are sugar maple and beech. Associated species include red oak, ash, basswood, hickory, yellow-poplar, white oak, elm, and walnut. The dominant trees of all commercial species have the potential to reach a diameter of 2 feet at breast height.

If protected from grazing, all of the woodland in the county can regenerate to commercial species without any need for planting. If the single tree selection method of harvesting is used, the woodland regenerates to stands that are dominated by maple. Clearcutting of all stems in areas 0.5 acre or more in size results in the reproduction of a forest that has the greatest possible variety of species. Diameter limit cutting or heavy selection cutting can cause deterioration of the largest trees that are left in the stand. Stands in areas of very poorly drained and poorly drained soils are subject to windthrow if cutting reduces the stocking level below 60 percent of full stocking. The increased wetness following cutting also hinders the growth and reduces the quality of the remaining trees of sawtimber size.

Wild grapevine commonly is a problem in stands on the better drained sites. It can hinder the growth of trees and distort or destroy them. It spreads when trees are harvested. It can be controlled by cutting the vine wherever it is rooted and by treating the rooted stump with an approved herbicide.

Tree planting has been most successful in old fields where white pine, yellow-poplar, or red oak have been planted. These species survive best and grow best on somewhat poorly drained soils. Soils that have a slope of less than 2 percent are best suited to species that are tolerant of wet sites, such as red maple, silver maple, sweetgum, swamp white oak, bur oak, pin oak, and eastern cottonwood. Walnut grows best on deep, fertile, moist, well drained soils on bottom land and in areas on the adjacent terraces and slopes where the soils are 30 or more inches deep. In some areas seedling survival is highly dependent on control of competing vegetation. Competing plants that are more than 1 foot tall should be controlled by mowing or by applying herbicide.

The economic return from the sale of wood products is smaller than that from other products on individual farms in the county, although some good-quality sawlogs and veneer logs of 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.

Additional information about woodland management is available at local offices of the Ohio Department of Natural Resources, Division of Forestry; the Ohio 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; and *F*, a high content of rock fragments in the soil. 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, and F.

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

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along logging roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

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 and season of use are 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 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.

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 in 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 generally is the most common species on the soil and is 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 (fig. 12). 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

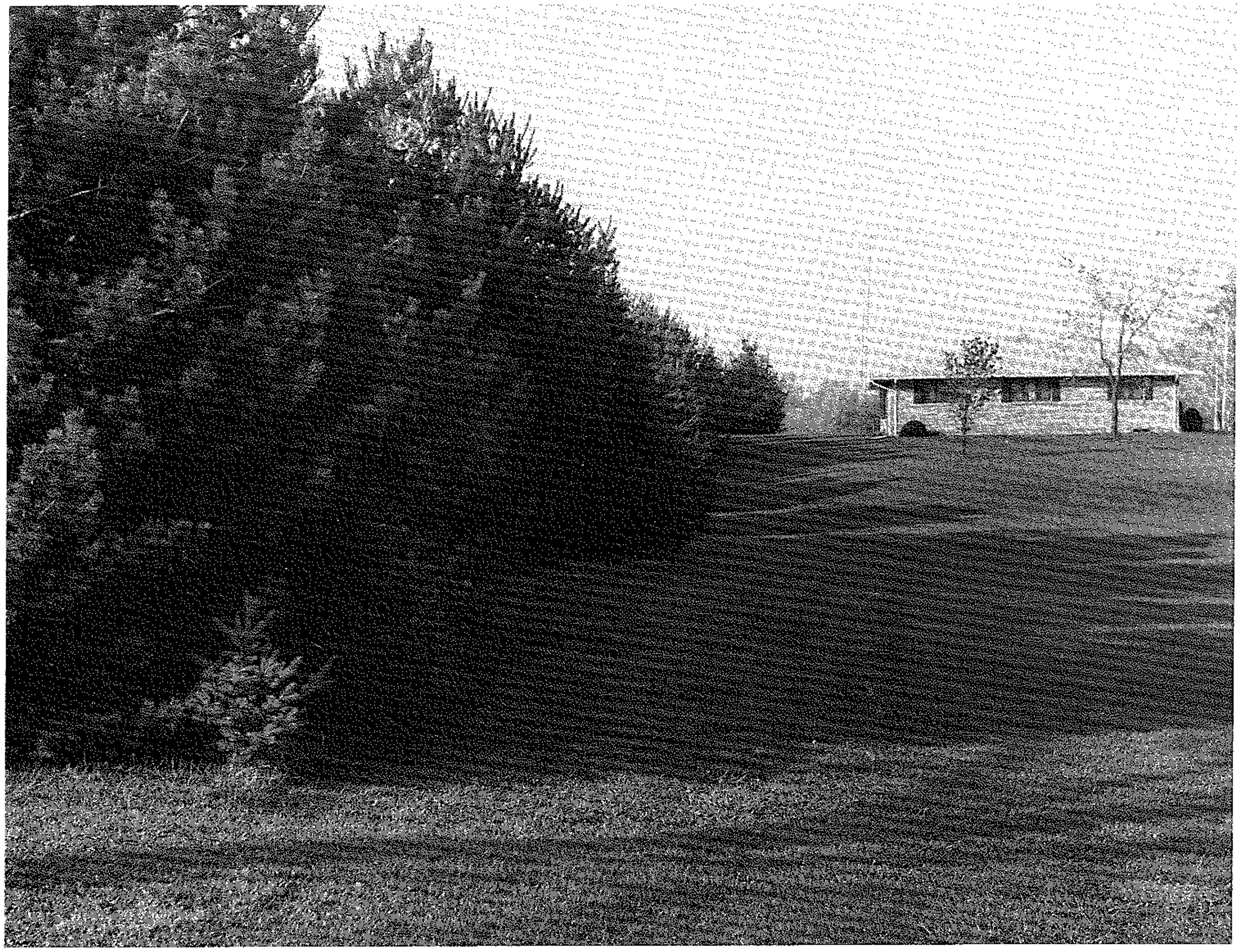

Figure 12.—A windbreak of conifers in an area of Cardington silt loam, 2 to 6 percent slopes.

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

Recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. 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 recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational 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

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.

Interpretations for wildlife can aid in the selection of suitable sites for the management of various kinds of habitat. These interpretations also are useful in broad-scale planning of wildlife management areas and in acquiring land to be used as wildlife habitat.

A shortage of adequate cover affects the wildlife population in Huron County. This shortage is a result of extensive fall plowing and the clearing of fence rows and woodlots. The wooded or idle areas on valley walls and flood plains provide important habitat for wildlife. The Saylesville and Orrville soils on flood plains are examples of soils that commonly provide good cover for wildlife. Flooding in areas of Lobdell and Orrville soils can damage nesting areas. The many drainage ditches throughout the county provide good habitat for wildlife.

Pinnebog soils and the ponded Carlisle soils provide excellent wetland wildlife habitat. The Pinnebog soils are in the Willard Marsh, and the ponded Carlisle soils occur as scattered pockets of muck throughout the county (fig. 13).

Most of the wooded areas in the county have been cut over. These areas now support brush and young trees that provide good habitat for deer. As a result, the deer population in the county has been increasing.

Additional information about wildlife habitat can be obtained from the local office of the Ohio Department of Natural Resources, Division of Wildlife, or the Soil Conservation Service.

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

Figure 13.—Wetland wildlife habitat in an area of Carlisle muck, ponded.

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 flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, soybeans, 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, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, smartweed, ragweed, and fescue.

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, maple, hawthorn, dogwood, hickory, and black walnut. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are shrub honeysuckle, autumn-olive, and crabapple.

Coniferous plants furnish browse 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, fir, 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, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, duckweed, reed canarygrass, cordgrass, 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. 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 wild turkey, ruffed grouse, 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, mink, and beaver.

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. Ratings are given for 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 should 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 or 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 kinds 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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 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, shrinking and swelling, 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 or 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 landfill. 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 resulting from rapid permeability in 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 should 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 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 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 wind erosion.

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 original 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 to 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, a 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 a 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 have a water table at a depth of 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. They 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 high water table at or near the surface.

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

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and grassed waterways.

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

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

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

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, 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 the potential for 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.

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

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

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. 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 to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

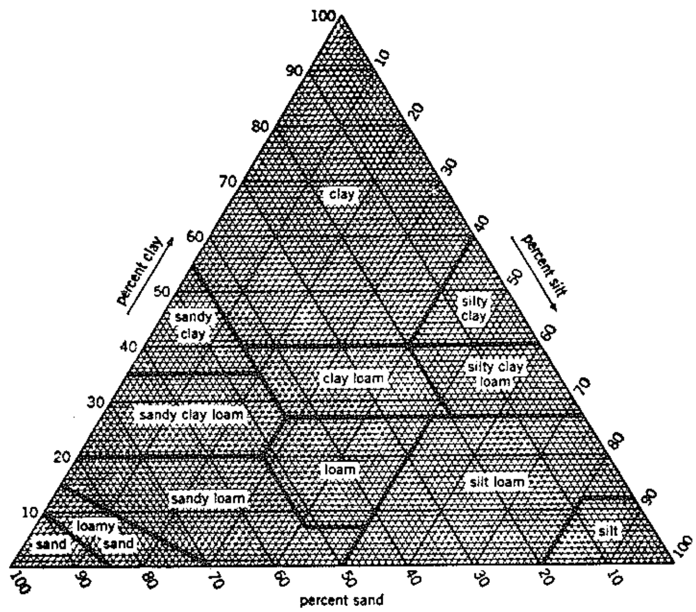

Figure 14.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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 the heading "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. 14). "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."

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.

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, 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 ⅓-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 and septic tank absorption fields.

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 classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, 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 coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

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 in 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 infiltration 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 (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

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 little or no horizon development.

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 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 results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

Several of the soils in Huron County were sampled for physical and chemical analyses. The data obtained from most of the samples included those pertaining to particle-size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations. These data were used in classifying and correlating the soils and in he evaluating their behavior under various land uses. Some of the sampled profiles were selected as representative of their respective series. These series and their laboratory identification numbers are Bennington series (HU-10, HU-12, and HU-16), Cardington series (HU-13 and HU-14), Condit series (HU-17), and Fries series (HU-15).

In addition to the data from Huron County, laboratory data are available for the same soils in many of the other counties in northern Ohio. These data and the data from Huron County are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Soil and Water Conservation, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio.

Engineering Index Test Data

Table 19 shows laboratory test data for 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 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); and Moisture density—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 *(20)*. 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. Eleven 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 Ochraqualfs (*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 is typical for the 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. Generally, 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 substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series correlated 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" *(17)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(20)*. 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."

Alexandria Series

The Alexandria series consists of deep, well drained soils that formed in moderately fine textured glacial till on till plains. Permeability is moderately slow. Slope is 12 to 50 percent.

Alexandria soils are similar to Saylesville soils and commonly are adjacent to Bennington, Cardington, Lobdell, and Tioga soils. Saylesville soils are underlain by lacustrine sediment. The somewhat poorly drained Bennington soils and the moderately well drained Cardington soils are in the less sloping areas. Lobdell and Tioga soils formed in alluvium on flood plains.

Typical pedon of Alexandria silty clay loam, 12 to 18 percent slopes, eroded, about 1 mile northeast of Willard, in New Haven Township; about 3,630 feet east and 1,650 feet south of the intersection of State Route 99 and County Road 12; quadrangle 3, lot 4; T. 1 N., R. 23 W.

Ap—0 to 5 inches; brown (10YR 4/3) silty clay loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

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

Bt2—14 to 20 inches; brown (10YR 4/3) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; common distinct brown (10YR 4/3) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

BC—20 to 27 inches; brown (10YR 4/3) silty clay loam; common coarse distinct yellowish brown (10YR 5/4) and few fine distinct grayish brown (10YR 5/2) mottles; weak coarse subangular structure; firm; few very fine roots; few distinct dark grayish brown (10YR 4/2) coatings on faces of peds; few distinct brown (10YR 4/3) clay films on faces of peds; light gray (10YR 7/2) deposits of secondary lime; few coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—27 to 60 inches; brown (10YR 4/3) silty clay loam; common coarse distinct yellowish brown (10YR 5/4) and common medium distinct gray (10YR 5/1) mottles; massive; firm; gray (10YR 5/1) seams; few distinct white (10YR 8/2) coatings of calcium carbonate in vertical partings; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 36 inches. The depth to free carbonates ranges from 20 to 36 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam. The Bt horizon has hue of 10YR or 7.5YR, 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 hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam or clay loam.

Bennington Series

The Bennington series consists of deep, somewhat poorly drained soils that formed dominantly in moderately fine textured glacial till on till plains. In a few areas these soils formed in water-modified glacial till on lake plains. Permeability is slow. Slope is 0 to 6 percent.

Bennington soils are similar to Blount soils and commonly are adjacent to Cardington, Condit, Lobdell, and Pandora soils. Blount soils have a higher calcium carbonate equivalent and fewer shale fragments in the glacial till than the Bennington soils. The moderately well drained Cardington soils are on knolls, ridges, and side slopes. The poorly drained Condit and Pandora soils are in drainageways and shallow depressions. The moderately well drained Lobdell soils formed in alluvium on flood plains.

Typical pedon of Bennington silt loam, 0 to 2 percent slopes, about 8 miles southwest of Monroeville, in Sherman Township; about 2,970 feet west and 412 feet north of the intersection of Township Road 29 and County Road 16; T. 3 N., R. 24 W.

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

Bt1—11 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine roots; many distinct grayish brown (10YR 5/2) coatings and few distinct grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; slightly acid; clear smooth boundary.

Bt2—16 to 23 inches; brown (10YR 4/3) clay; 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 fine roots; many distinct grayish brown (10YR 5/2) coatings and common clay films on faces of peds; few very dark (10YR 2/2) stains of iron and manganese oxide; few coarse fragments; strongly acid; clear smooth boundary.

Bt3—23 to 29 inches; dark yellowish brown (10YR 4/4) silty clay; common medium faint yellowish brown (10YR 5/4) mottles; moderate medium and coarse subangular blocky structure; firm; many distinct grayish brown (10YR 5/2) coatings and clay films on faces of peds; few coarse fragments; neutral; clear wavy boundary.

BC—29 to 40 inches; brown (10YR 4/3) silty clay loam; common medium faint yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct gray (10YR 5/1) coatings and few distinct gray (10YR 5/1) clay films on faces of peds; few light gray (10YR 7/1) coatings of calcium carbonate in vertical partings; about 5 percent coarse fragments; slight effervescence; mildly alkaline grading to moderately alkaline in the lower part; clear wavy boundary.

C1—40 to 48 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive but parts to weak thick plates; firm; few fine roots; common distinct gray (10YR 5/1) coatings on faces of plates; few distinct light gray (10YR 7/1) coatings of calcium carbonate in vertical partings; about 6 percent coarse fragments; slight effervescence; moderately alkaline; clear smooth boundary.

C2—48 to 60 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct brownish yellow (10YR 6/6) mottles; massive; firm; common distinct gray (10YR 5/1) coatings in vertical partings; about 6 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 50 inches. The depth to carbonates ranges from 26 to 46 inches. The content of coarse fragments ranges from 0 to 5 percent within a depth of 20 inches and from 2 to 10 percent below that depth.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It commonly is silt loam but is loam in some pedons. 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, clay loam, clay, or silty clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is clay loam or silty clay loam.

Bixler Series

The Bixler series consists of deep, somewhat poorly drained soils that formed in glacial outwash over stratified lacustrine material. These soils are on lake plains and beach ridges. Permeability is rapid in the outwash and moderate in the lacustrine material. Slope is 0 to 2 percent.

Bixler soils commonly are adjacent to Kibbie, Spinks, and Tuscola soils. Kibbie soils have a dark surface layer. They are in the slightly lower positions on the landscape. The well drained Spinks soils are on the higher beach ridges. The moderately well drained Tuscola soils are in the slightly higher positions on the landscape.

Typical pedon of Bixler loamy fine sand, 0 to 2 percent slopes, about 2 miles north of Norwalk, in Norwalk Township; about 1,814 feet west and 330 feet south of the intersection of State Route 601 and Township Road 52; quadrangle 3, lot 61; T. 4 N., R. 22 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many medium and fine roots; neutral; clear smooth boundary.

E1—9 to 13 inches; brown (10YR 4/3) loamy fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine granular structure; very friable; common medium and fine roots; common faint dark brown (10YR 3/3) silt coatings on faces of peds; few black (10YR 2/1) concretions of iron and manganese oxide; few prominent strong brown (7.5YR 5/8) stains; neutral; clear wavy boundary.

E2—13 to 19 inches; light yellowish brown (10YR 6/4) loamy fine sand; many fine distinct yellowish brown (10YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure parting to weak fine granular; very friable; common medium and fine roots; few black (10YR 2/1) concretions of iron and manganese oxide; few prominent strong brown (7.5YR 5/6) iron stains; neutral; clear wavy boundary.

E3—19 to 25 inches; pale brown (10YR 6/3) loamy fine sand; many medium distinct brown (7.5YR 4/4), common medium prominent reddish brown (5YR 4/4), and common medium faint light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure parting to weak fine granular; very friable; few fine roots; common black (10YR 2/1) concretions of iron and manganese oxide; few brown (10YR 4/3) clay-enriched zones; neutral; clear wavy boundary.

E4—25 to 31 inches; brown (10YR 5/3) loamy fine sand; many medium distinct light brownish gray (10YR 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to weak fine granular; very friable; few fine roots; many distinct black (10YR 2/1) concretions of iron and manganese oxide;

common prominent reddish brown (5YR 4/4) iron stains; neutral; clear wavy boundary.

Bt1—31 to 35 inches; brown (10YR 5/3) fine sandy loam; common medium distinct light brownish gray (10YR 6/2) and common medium distinct brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; friable; few fine roots; few distinct brown (10YR 4/3) clay films bridging sand grains; common black (10YR 2/1) concretions of iron and manganese oxide; few reddish brown (5YR 4/4) iron stains; neutral; clear wavy boundary.

2Bt2—35 to 43 inches; grayish brown (10YR 5/2) silt loam stratified with thin lenses of silty clay loam; many medium distinct dark yellowish brown (10YR 4/4) and few medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common distinct brown (10YR 5/3) clay films on faces of peds; neutral; clear wavy boundary.

2C—43 to 60 inches; brown (10YR 5/3), stratified loamy fine sand and fine sandy loam having thin lenses of silt loam; many medium distinct yellowish brown (10YR 5/6) and many medium distinct gray (10YR 5/1) mottles; massive; very friable; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 28 to 55 inches. The Ap horizon has value of 2 to 4 and chroma of 1 to 3. It typically is loamy fine sand but is fine sand in some pedons. The E horizon has value of 4 to 6 and chroma of 3 or 4. It is loamy fine sand or fine sand. The Bt and 2Bt horizons have hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. The Bt horizon is fine sandy loam, loam, or sandy loam. The 2Bt horizon is dominantly silt loam or loam, but in some pedons it has thin strata of silty clay loam. The 2C 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 3.

Blount Series

The Blount series consists of deep, somewhat poorly drained soils that formed in moderately fine textured glacial till high in content of lime. These soils are on till plains. Permeability is moderately slow or slow. Slope is 0 to 6 percent.

Blount soils are similar to Bennington soils and commonly are adjacent to Glynwood, Milton, and Pandora soils. Bennington soils have a lower calcium carbonate equivalent and a higher content of shale in the glacial till than the Blount soils. The moderately well drained Glynwood soils are on the slightly higher or more sloping parts of the landscape. The well drained Milton soils have limestone bedrock at a depth of 20 to 40 inches. The poorly drained Pandora soils are in depressions and along drainageways.

Typical pedon of Blount silt loam, 0 to 2 percent slopes, about 6 miles northwest of Willard, in Norwich Township; about 2,640 feet north and 824 feet east of the intersection of Township Roads 102 and 10; quadrangle 4, lot 1; T. 2 N., R. 24 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium and fine granular structure; friable; many medium and fine roots; few coarse fragments; neutral; abrupt smooth boundary.

Bt1—8 to 11 inches; brown (10YR 5/3) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) and few medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; few fine roots; many distinct light brownish gray (10YR 6/2) coatings and few distinct brown (10YR 5/3) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt2—11 to 18 inches; dark yellowish brown (10YR 4/4) silty clay; many medium prominent dark brown (7.5YR 4/2) and common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct grayish brown (10YR 5/2) coatings and many distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; slightly acid; clear wavy boundary.

Bt3—18 to 30 inches; brown (10YR 4/3) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) and few medium distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct light brownish gray (10YR 6/2) coatings and many distinct light brownish gray (10YR 6/2) clay films on faces of peds; few medium black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; medium acid; clear wavy boundary.

BC—30 to 39 inches; brown (10YR 4/3) silty clay loam; many medium distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to weak coarse subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) coatings and few distinct grayish brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—39 to 54 inches; brown (10YR 4/3) clay loam;

common medium distinct yellowish brown (10YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; massive; firm; common distinct grayish brown (10YR 5/2) vertical seams; few fine black (10YR 2/1) stains of iron and manganese oxide; few distinct light gray (10YR 7/1) coatings of calcium carbonate in vertical partings; about 7 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—54 to 60 inches; brown (10YR 4/3) clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; grayish brown (10YR 5/2) vertical seams; few light gray (10YR 7/1) coatings of calcium carbonate in vertical partings; about 7 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 45 inches. The depth to free carbonates ranges from 19 to 40 inches.

The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is silty clay loam, clay loam, silty clay, or clay. The BC and C horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. They are clay loam or silty clay loam.

Brecksville Series

The Brecksville series consists of moderately deep, well drained soils that formed in residuum of thinly bedded shale bedrock on dissected uplands. Permeability is slow. Slope is 40 to 70 percent.

Brecksville soils commonly are adjacent to Bennington, Jimtown, Kibbie, Lobdell, Tioga, and Tuscola soils. The somewhat poorly drained Bennington, Jimtown, and Kibbie soils are on upland flats adjacent to steep breaks. The moderately well drained Tuscola soils are on uplands. The deep, moderately well drained Lobdell soils and the deep, well drained Tioga soils are on flood plains below the Brecksville soils.

Typical pedon of Brecksville silt loam, 40 to 70 percent slopes, about 3 miles north of Monroeville, in Ridgefield Township; about 100 feet east and 250 feet north of the intersection of Township Roads 118 and 116; quadrangle 2, lot 15; T. 4 N., R. 23 W.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; about 5 percent soft, weathered shale fragments; neutral; clear wavy boundary.

AB—4 to 11 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium and fine subangular blocky structure; friable; many medium and fine roots; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; about 10 percent soft, weathered shale fragments; neutral; clear wavy boundary.

Bw—11 to 24 inches; yellowish brown (10YR 5/4) channery silt loam; weak fine subangular blocky structure; friable; common medium and fine roots; about 25 percent shale fragments; medium acid; gradual wavy boundary.

BC—24 to 29 inches; yellowish brown (10YR 5/4) shaly silt loam; weak fine subangular blocky structure; friable; few medium and fine roots; about 30 percent shale fragments; strongly acid; clear wavy boundary.

Cr—29 inches; light olive brown (2.5Y 5/4), weathered shale bedrock.

The thickness of the solum and the depth to paralithic contact range from 20 to 40 inches. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the A horizon and from 5 to 25 percent in the B horizon. It increases with increasing depth.

The A horizon has value of 2 to 4 and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 or 4. It is silt loam, silty clay loam, or the channery analogs of those textures. Some pedons have a C horizon. This horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is channery or very channery silt loam or silty clay loam.

Cardington Series

The Cardington series consists of deep, moderately well drained soils that formed in moderately fine textured glacial till on till plains and moraines. Permeability is moderately slow or slow. Slope is 2 to 12 percent.

Cardington soils are similar to Glynwood and Shinrock soils and commonly are adjacent to Alexandria, Bennington, and Condit soils. Glynwood soils have a higher calcium carbonate equivalent and fewer shale fragments in the glacial till than the Cardington soils. Shinrock soils formed in lacustrine sediment on lake plains. The well drained Alexandria soils are on the steeper side slopes. The somewhat poorly drained Bennington soils are on the lower side slopes and in the less sloping areas. The poorly drained Condit soils are in depressions and along drainageways.

Typical pedon of Cardington silt loam, 2 to 6 percent slopes, about 2 miles east of Clarksfield, in Clarksfield Township; about 3,134 feet north of the intersection of

Township Roads 183 and 186, along Township Road 183, then 246 feet west; quadrangle 2, lot 20; T. 3 N., R. 20 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, very pale brown (10YR 7/3) dry; weak medium and fine granular structure; friable; many fine roots; strongly acid; abrupt wavy boundary.

BE—7 to 11 inches; yellowish brown (10YR 5/4) silt loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; many fine roots; common distinct pale brown (10YR 6/3) silt coatings on faces of peds; few distinct light brownish gray (10YR 6/2) degradation faces; few coarse fragments; very strongly acid; clear wavy boundary.

Bt1—11 to 17 inches; brown (10YR 4/3) silty clay; few medium distinct dark yellowish brown (10YR 3/4) and grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; common fine roots; common distinct grayish brown (10YR 5/2) coatings and many distinct dark brown (10YR 4/3) clay films on faces of peds; few coarse fragments; very strongly acid; clear wavy boundary.

Bt2—17 to 24 inches; brown (10YR 4/3) silty clay; many medium distinct yellowish brown (10YR 5/6) and few fine distinct gray (10YR 5/1) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few medium roots; common distinct brown (10YR 4/3) coatings and many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common medium very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; strongly acid; clear wavy boundary.

Bt3—24 to 29 inches; brown (10YR 4/3) clay; many medium distinct yellowish brown (10YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few medium roots; common distinct dark grayish brown (10YR 4/2) coatings and common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; neutral; clear smooth boundary.

BC—29 to 34 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate coarse subangular blocky; firm; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few distinct light gray (10YR 7/2) coatings of calcium carbonate in vertical partings; few coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—34 to 60 inches; brown (10YR 5/3) clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; very firm; few distinct light gray (10YR 7/2) coatings of calcium carbonate in vertical partings; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 50 inches. The depth to carbonates ranges from 26 to 45 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay, clay, silty clay loam, or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is clay loam or silty clay loam.

Carlisle Series

The Carlisle series consists of deep, very poorly drained soils that formed in organic material in bogs on lake plains and till plains. Permeability is moderately rapid to moderately slow. Slope is 0 to 2 percent.

Carlisle soils are similar to Pinnebog soils and commonly are adjacent to Colwood, Lenawee Variant, Linwood, and Pinnebog soils. Pinnebog soils contain more fibrous material in the organic layers than the Carlisle soils. They are in landscape positions similar to those of the Carlisle soils. The mineral Colwood soils are at the slightly higher elevations. Lenawee Variant soils formed in lacustrine sediment and once had an organic surface layer, which was destroyed when the soils were drained and cultivated. Linwood soils are underlain by loamy lacustrine material within 51 inches of the surface. They are in landscape positions similar to those of the Carlisle soils.

Typical pedon of Carlisle muck, about 3 miles south of Willard, in Richmond Township; about 824 feet south and 5,940 feet west of the intersection of State Route 103 and Township Road 220; quadrangle 1, lot 21; T. 1 N., R. 24 W.

Op—0 to 9 inches; sapric material (muck), black (10YR 2/1) broken face and rubbed; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

Oa1—9 to 11 inches; sapric material (muck), dark reddish brown (5YR 3/3) broken face, black (N 2/0) rubbed; about 70 percent fiber, 10 percent rubbed; weak medium granular structure; friable; slightly acid; abrupt wavy boundary.

Oa2—11 to 15 inches; sapric material (muck), black (N 2/0) and very dark gray (10YR 3/1) broken face and rubbed; about 10 percent fiber, less than 1 percent rubbed; weak coarse granular structure; friable; slightly acid; gradual smooth boundary.

Oa3—15 to 25 inches; sapric material (muck), dark reddish brown (5YR 3/3) broken face, very dark gray (10YR 3/1) rubbed; about 40 percent fiber, 2 percent rubbed; massive; friable; neutral; gradual smooth boundary.

Oa4—25 to 33 inches; sapric material (muck), dark reddish brown (5YR 3/3) broken face, black (N 2/0) rubbed; about 40 percent fiber, 3 percent rubbed; massive; friable; few woody fragments; neutral; gradual smooth boundary.

Oa5—33 to 43 inches; sapric material (muck), dark reddish brown (5YR 3/3) broken face, very dark gray (10YR 3/1) rubbed; about 40 percent fiber, 4 percent rubbed; massive; friable; few woody fragments; slightly acid; gradual smooth boundary.

Oa6—43 to 60 inches; sapric material (muck), dark brown (10YR 3/4) broken face, very dark gray (10YR 3/1) rubbed; about 60 percent fiber, 5 percent rubbed; massive; friable; few woody fragments; slightly acid.

The surface and subsurface tiers have hue of 10YR to 5YR They have value of 2 or 3 and chroma of 0 to 3. The subsurface tier contains 5 to 70 percent fiber before rubbing and less than 10 percent after rubbing. The bottom tier has hue of 5YR to 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 4. It is dominantly friable sapric material, but in some pedons it has thin layers of hemic material.

Castalia Series

The Castalia series consists of moderately deep, well drained soils that formed in residuum on bedrock-controlled rises and knolls on uplands. Permeability is rapid. Slope is 2 to 6 percent.

Castalia soils commonly are adjacent to Millsdale, Milton, and Pewamo soils. The very poorly drained Millsdale soils are in depressions. Milton soils formed in glacial till and have fewer coarse fragments in the subsoil and substratum than the Castalia soils. They are in landscape positions similar to those of the Castalia soils. The deep, very poorly drained Pewamo soils are in depressions and on broad flats.

Typical pedon of Castalia channery silt loam, 2 to 6 percent slopes, about 3 miles east of Bellevue, in Lyme Township; about 6,430 feet north of the intersection of Township Roads 40 and 41, along Township Road 40, then 30 feet east; quadrangle 2, lot 3; T. 4 N., R. 24 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) channery silt loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; many fine roots; about 15 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

Bw—7 to 17 inches; reddish brown (5YR 4/4) very channery silt loam; moderate medium and fine subangular blocky structure; friable; many fine roots; common distinct dark brown (7.5YR 3/2) organic stains on faces of peds; about 50 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—17 to 22 inches; reddish brown (5YR 4/4) extremely flaggy silt loam; reddish brown (5YR 4/4) soil material in cracks; friable; few fine roots; about 90 percent coarse fragments; strong effervescence; moderately alkaline; gradual irregular boundary.

R—22 inches; fractured limestone bedrock.

The depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments ranges from 30 to 80 percent in the B horizon and from 70 to 90 percent in the C horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw and C horizons have hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 3 to 6. In the fine-earth fraction, they are silt loam, loam, fine sandy loam, or sandy loam.

Chili Series

The Chili series consists of deep, well drained soils that formed in moderately coarse textured material on outwash plains, terraces, kames, beach ridges, and till plains. Permeability is moderately rapid. Slope is 2 to 30 percent.

Chili soils commonly are adjacent to Cardington, Haskins, Jimtown, Lobdell, and Oshtemo soils. The moderately well drained Cardington soils formed in glacial till and have more clay in the subsoil and substratum than the Chili soils. The somewhat poorly drained Haskins and Jimtown soils are in the lower, less sloping areas. The moderately well drained Lobdell soils are on flood plains along streams. Oshtemo soils have more sand and less clay in the subsoil than the Chili soils. They are on beach ridges.

Typical pedon of Chili loam, loamy substratum, 2 to 6 percent slopes, about 3 miles southeast of Wakeman, in Wakeman Township; about 2,640 feet northeast of the intersection of Township Roads 183 and 163, along Township Road 183, and about 30 feet east of Township Road 183; quadrangle 1, lot 59; T. 4 N., R. 20 W.

Ap—0 to 8 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak medium and fine granular structure; friable; common fine roots; about 5 percent coarse fragments; slightly acid; clear smooth boundary.

Bt1—8 to 17 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; friable; few fine roots; common distinct brown (7.5YR 4/4) clay films on faces of peds; brown (10YR 4/3) organic coatings on coarse fragments; about 10 percent coarse fragments; slightly acid; clear wavy boundary.

Bt2—17 to 24 inches; brown (7.5YR 4/4) gravelly clay loam; few medium distinct strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; friable; few fine roots; many distinct brown (7.5YR 4/4) clay films on faces of peds and coatings on coarse fragments; about 20 percent coarse fragments; slightly acid; clear wavy boundary.

Bt3—24 to 34 inches; brown (7.5YR 4/4) gravelly loam; common medium distinct dark brown (10YR 4/3) mottles; weak coarse subangular blocky structure; friable; few fine roots; common distinct brown (10YR 4/3) clay films bridging sand grains; about 30 percent coarse fragments; medium acid; clear wavy boundary.

BC—34 to 45 inches; brown (10YR 4/3) very gravelly sandy loam; common medium distinct brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very friable; few distinct brown (10YR 4/3) clay films bridging sand grains; about 40 percent coarse fragments; strongly acid; clear wavy boundary.

C—45 to 60 inches; brown (10YR 4/3) very gravelly sandy loam; massive; very friable; loose; about 40 percent gravel; strongly acid.

The thickness of the solum ranges from 40 to 80 inches. The content of coarse fragments ranges from 0 to 30 percent within a depth of 20 inches, from 10 to 40 percent between depths of 20 to 40 inches, and from 25 to 50 percent below a depth of 40 inches.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It commonly is loam, but in some pedons it is sandy loam, fine sandy loam, or gravelly sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It commonly is sandy loam, loam, clay loam, or sandy clay loam. In the lower part of the horizon, however, the range includes the gravelly or very gravelly analogs of those textures.

The BC horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It commonly is gravelly or very gravelly loam or sandy loam.

The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It is gravelly or very gravelly sandy loam or loam.

Colwood Series

The Colwood series consists of deep, very poorly drained soils that formed in stratified, medium textured lacustrine sediment and outwash deposits. These soils generally are on lake plains and outwash plains, but in a few areas they are on till plains. Permeability is moderate. Slope is 0 to 2 percent.

Colwood soils commonly are adjacent to Kibbie, Haskins, Lenawee, Oshtemo, and Pewamo soils. The somewhat poorly drained Kibbie and Haskins soils are in the slightly higher positions on the landscape. Lenawee soils have more clay in the subsoil than the Colwood soils. They are in landscape positions similar to those of the Colwood soils. The well drained Oshtemo soils are on gently sloping beach ridges. Pewamo soils formed in lacustrine sediment and glacial till.

Typical pedon of Colwood silt loam, about 2 miles south of Willard, in New Haven Township; about 2,140 feet south and 400 feet west of the intersection of Township Roads 196 and 206; quadrangle 4, lot 2; T. 1 N., R. 23 W.

Ap—0 to 11 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium and fine granular structure; friable; common medium and fine roots; neutral; clear smooth boundary.

Bg1—11 to 15 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) and few medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; many distinct very dark gray (10YR 3/1) organic coatings on faces of peds; very dark gray (10YR 3/1) krotovinas; common prominent reddish brown (5YR 4/4) stains; few coarse fragments; neutral; clear wavy boundary.

Bg2—15 to 23 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent dark brown (7.5YR 4/4) and few medium faint light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; few distinct very dark gray (10YR 3/1) organic coatings on faces of peds; very dark gray (10YR 3/1) krotovinas; common prominent reddish brown (5YR 4/4) stains; few coarse fragments; neutral; clear wavy boundary.

Bg3—23 to 31 inches; grayish brown (10YR 5/2) loam; common medium distinct yellowish brown (10YR 5/4) and common medium faint light brownish gray

(10YR 6/2) mottles; weak medium subangular blocky structure; friable; few fine roots; very dark gray (10YR 3/1) krotovinas; common prominent reddish brown (5YR 4/4) stains; few coarse fragments; mildly alkaline; clear wavy boundary.

Cg1—31 to 38 inches; light brownish gray (10YR 6/2) loam; common medium distinct brown (10YR 5/3) and common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; few fine roots; pockets of loamy sand; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

Cg2—38 to 60 inches; grayish brown (10YR 5/2) silt loam; many coarse prominent yellowish brown (10YR 5/6) and common coarse distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 50 inches. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The B and C horizons have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. The B horizon is silty clay loam, silt loam, clay loam, loam, sandy loam, fine sandy loam, or very fine sandy loam. The C horizon is stratified silt loam, very fine sand, loamy fine sand, or loam.

Condit Series

The Condit series consists of deep, poorly drained soils that formed in glacial till on till plains. Permeability is slow. Slope is 0 to 2 percent.

Condit soils are similar to Miner and Pandora soils and commonly are adjacent to Bennington and Cardington soils. Miner soils have a dark surface layer. Pandora soils are less acid in the subsoil than the Condit soils. The somewhat poorly drained Bennington soils and the moderately well drained Cardington soils are in the higher positions on the landscape or in the more sloping areas.

Typical pedon of Condit silty clay loam, about 5 miles northeast of New London, in Clarksfield Township; about 3,300 feet south and 164 feet west of the intersection of Township Roads 188 and 184; quadrangle 1, lot 17; T. 3 N., R. 20 W.

A—0 to 2 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; weak medium and fine granular structure; friable; many fine roots; many dark gray (10YR 4/1) organic coatings; strongly acid; clear smooth boundary.

AB—2 to 6 inches; dark gray (10YR 4/1) silty clay loam; few medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common fine roots; common distinct dark grayish brown (10YR 4/2) coatings on faces of peds; common prominent strong brown (7.5YR 4/6) stains of iron and manganese oxide; few coarse fragments; very strongly acid; clear wavy boundary.

Btg1—6 to 16 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/8) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few medium and fine roots; common distinct gray (10YR 5/1) clay films on faces of peds; few coarse fragments; very strongly acid; gradual smooth boundary.

Btg2—16 to 25 inches; grayish brown (10YR 5/2) silty clay; many medium distinct yellowish brown (10YR 5/6) and few medium distinct dark yellowish brown (10YR 4/4) mottles; strong coarse prismatic structure parting to moderate medium subangular blocky; firm; few medium roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; strongly acid; gradual smooth boundary.

Btg3—25 to 38 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; strong coarse prismatic structure parting to moderate coarse subangular blocky; firm; few medium roots; common distinct gray (10YR 5/1) coatings on faces of peds; common distinct gray (10YR 5/1) clay films on faces of peds; few distinct black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; neutral; gradual wavy boundary.

BCg—38 to 44 inches; gray (10YR 6/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few medium and fine roots; many distinct gray (10YR 5/1) coatings on faces of peds; few white (10YR 8/2) coatings of calcium carbonate in vertical partings; few coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1—44 to 51 inches; brown (10YR 5/3) silty clay loam; many medium distinct gray (10YR 6/1) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few white (10YR 8/2) coatings of calcium carbonate in vertical partings; few coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C2—51 to 60 inches; yellowish brown (10YR 5/6) silt loam; common medium prominent light brownish gray (10YR 6/2) mottles; massive; firm; gray (10YR

5/1) coatings on vertical seams; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 55 inches. It is about the same as the depth to carbonates. The content of coarse fragments ranges from 0 to 5 percent in the A horizon and from 2 to 15 percent in the B and C horizons.

The A or Ap horizon has value of 3 to 5 and chroma of 1 or 2. The B 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 is silty clay loam, clay loam, or silty clay. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 6. It is silty clay loam, clay loam, loam, or silt loam.

Elnora Series

The Elnora series consists of deep, moderately well drained soils that formed in coarse textured sediment on low beach ridges, sand dunes, lake plains, and deltas. Permeability is rapid. Slope is 1 to 3 percent.

Elnora soils commonly are adjacent to Kibbie, Oshtemo, Spinks, and Tuscola soils. The somewhat poorly drained Kibbie soils are in the lower positions on the landscape. The well drained Oshtemo and Spinks soils are in the higher positions on beach ridges. Tuscola soils have more clay in the subsoil and substratum than the Elnora soils. They are in the lower positions on lake plains.

Typical pedon of Elnora loamy fine sand, 1 to 3 percent slopes, about 3 miles northeast of Norwalk, in Norwalk Township; about 1,980 feet northwest of the intersection of State Routes 601 and 61, along State Route 601, then about 1,320 feet north; quadrangle 2, lot 32; T. 4 N., R. 22 W.

Ap—0 to 14 inches; dark brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; common fine roots; very strongly acid; abrupt wavy boundary.

Bw1—14 to 20 inches; yellowish brown (10YR 5/6) loamy fine sand; few fine distinct yellowish brown (10YR 4/6) mottles; weak fine granular structure; very friable; few fine roots; few fine dark brown (10YR 3/3) stains on faces of root channels; slightly acid; clear wavy boundary.

Bw2—20 to 24 inches; dark yellowish brown (10YR 4/6) loamy fine sand; common medium distinct strong brown (7.5YR 4/6) and few fine distinct brown (10YR 5/3) mottles; weak medium and fine granular structure; very friable; few fine roots; few distinct strong brown (7.5YR 4/6) coatings on faces of peds; few fine black (10YR 2/1) concretions of iron and manganese oxide; few coarse fragments; slightly acid; clear wavy boundary.

Bw3—24 to 29 inches; yellowish brown (10YR 5/6) loamy fine sand; common medium distinct brown (10YR 4/3) and strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; very friable; few fine roots; few distinct yellowish brown (10YR 5/4) coatings on faces of peds; few black (10YR 2/1) concretions of iron and manganese oxide; few coarse fragments; slightly acid; gradual wavy boundary.

Bw4—29 to 40 inches; yellowish brown (10YR 5/4) loamy fine sand; common coarse distinct light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; very friable; few fine roots; few prominent dark reddish brown (5YR 3/2) iron-enriched zones; slightly acid; clear wavy boundary.

C1—40 to 48 inches; brown (10YR 5/3) loamy fine sand; few coarse distinct dark yellowish brown (10YR 4/6) and few fine distinct light brownish gray (10YR 6/2) mottles; single grain; loose; few fine roots; few prominent dark reddish brown (5YR 3/2) iron-enriched zones; slightly acid; clear wavy boundary.

C2—48 to 56 inches; brown (7.5YR 4/4) loamy fine sand; many medium distinct light brownish gray (10YR 6/2) mottles; single grain; loose; strongly acid; clear wavy boundary.

C3—56 to 60 inches; dark yellowish brown (10YR 4/4) loamy fine sand; common fine distinct brown (7.5YR 4/4) and few fine distinct light brownish gray (10YR 6/2) mottles; single grain; loose; medium acid.

The thickness of the solum ranges from 24 to 40 inches. The Ap horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or 3. The Bw and C horizons are loamy fine sand or fine sand. The Bw horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 6. The C horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 1 to 4.

Fries Series

The Fries series consists of moderately deep, very poorly drained soils on lake plains and till plains. These soils formed in glacial till or lacustrine sediment. They are underlain by shale at a depth of 20 to 40 inches. Permeability is slow. Slope is 0 to 2 percent.

Fries soils are similar to Millsdale soils and commonly are adjacent to Bennington, Haskins, Otisville, Pewamo, and Prout soils. Millsdale soils are underlain by limestone. The somewhat poorly drained Bennington, Haskins, and Prout soils are in the slightly higher positions on the landscape. The well drained

Otisville soils are on the higher beach ridges. Pewamo soils do not have bedrock within 40 inches of the surface. They are in positions on the landscape similar to those of the Fries soils.

Typical pedon of Fries silty clay loam, about 3 miles southeast of Bellevue, in Lyme Township; about 2,310 feet south and 75 feet west of the intersection of Township Road 23 and County Road 30; quadrangle 4, lot 14; T. 4 N., R. 24 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak medium and fine granular; firm; common fine roots; slightly acid; abrupt smooth boundary.

A—10 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; firm; common fine roots; few pebbles; medium acid; clear wavy boundary.

Bg—14 to 22 inches; dark gray (10YR 4/1) silty clay loam; common medium faint dark grayish brown (10YR 4/2) and few medium prominent yellowish brown (10YR 5/6) mottles; moderate medium and fine angular blocky structure; firm; common fine roots; common distinct black (10YR 2/1) and very dark gray (10YR 3/1) organic coatings on faces of peds; few pebbles; medium acid; clear wavy boundary.

Bw—22 to 30 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct gray (10YR 5/1), dark grayish brown (10YR 4/2), and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; common distinct gray (10YR 5/1) coatings and common distinct black (10YR 2/1) organic coatings on faces of peds; dark gray (10YR 4/1) krotovinas; few pebbles; slightly acid; clear wavy boundary.

2Cr—30 to 37 inches; gray (10YR 5/1) and yellowish brown (10YR 5/8), soft shale bedrock.

The thickness of the solum ranges from 20 to 32 inches. The depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 5 percent in the Ap and A horizons and from 0 to 10 percent in the B horizon.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 8. It is silty clay loam, silty clay, or clay loam.

Glynwood Series

The Glynwood series consists of deep, moderately well drained soils that formed in moderately fine textured glacial till high in content of lime. These soils are on till plains. Permeability is slow. Slope is 2 to 6 percent.

Glynwood soils are similar to Cardington soils and commonly are adjacent to Blount and Pandora soils. Cardington soils have a lower calcium carbonate equivalent and a higher content of shale in the glacial till than the Glynwood soils. The somewhat poorly drained Blount soils are on the broader slopes or in the less sloping areas. The poorly drained Pandora soils are in depressions and along drainageways.

Typical pedon of Glynwood silty clay loam, 2 to 6 percent slopes, eroded, about 6 miles west of Willard, in Norwich Township; about 1,980 feet north and 700 feet east of the intersection of Township Roads 102 and 10; quadrangle 4, lot 1; T. 2 N., R. 24 W.

Ap—0 to 8 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; mixed with light yellowish brown (10YR 5/6) material from the subsoil; moderate medium and fine granular structure; friable; few fine roots; few coarse fragments; neutral; abrupt smooth boundary.

Bt1—8 to 13 inches; yellowish brown (10YR 5/6) silty clay; common medium distinct dark yellowish brown (10YR 4/4) and common medium prominent grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) coatings and common distinct brown (10YR 4/3) clay films on faces of peds; few coarse fragments; neutral; clear wavy boundary.

Bt2—13 to 17 inches; dark yellowish brown (10YR 4/4) silty clay; common medium faint brown (10YR 4/3) and few medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct brown (10YR 4/3) clay films and common distinct brown (10YR 4/3) and dark grayish brown (10YR 4/2) coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; neutral; clear wavy boundary.

Bt3—17 to 22 inches; brown (10YR 4/3) silty clay; common medium faint dark yellowish brown (10YR 4/4) and common medium faint dark grayish brown (10YR 4/2) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; many distinct dark grayish brown (10YR 4/2) clay films and common distinct brown (10YR 4/3) coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; neutral; clear wavy boundary.

BC—22 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; few distinct grayish brown (10YR 5/2) clay films and coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; few distinct light gray (10YR 7/1) coatings of calcium carbonate in vertical partings; few coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—27 to 60 inches; brown (10YR 4/3) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) mottles; massive; firm; grayish brown (10YR 5/2) vertical seams; common light gray (10YR 7/1) coatings of calcium carbonate in vertical partings; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 40 inches. The depth to free carbonates ranges from 16 to 36 inches. The content of coarse fragments ranges from 0 to 5 percent in the Ap and E horizons, from 0 to 10 percent in the Bt horizon, and from 1 to 15 percent in the BC and C horizons.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is silty clay, clay, silty clay loam, or clay loam. The BC and C horizons are clay loam or silty clay loam. The BC horizon has colors similar to those of the Bt horizon. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6.

Haskins Series

The Haskins series consists of deep, somewhat poorly drained soils that formed in medium textured outwash and in the underlying moderately fine textured glacial till or lacustrine sediment. These soils are on low beach ridges, terraces, outwash plains, and till plains. Permeability is moderate in the upper part of the subsoil and slow in the lower part and in the substratum. Slope is 0 to 3 percent.

Haskins soils are similar to Jimtown soils and commonly are adjacent to Bennington, Cardington, Chili, Lobdell, and Oshtemo soils. Jimtown soils contain less clay and more sand in the lower part of the subsoil and in the substratum than the Haskins soils. Bennington soils and the moderately well drained Cardington soils have more clay and less sand in the subsoil than the Haskins soils. They are in the slightly higher positions on till plains. The well drained Chili and Oshtemo soils are in the higher positions on beach ridges and terraces. The moderately well drained Lobdell soils are in the lower positions on flood plains.

Typical pedon of Haskins loam, 0 to 3 percent slopes, about 4 miles southwest of Monroeville, in Sherman Township; about 3,464 feet south and 400 feet east of the intersection of State Route 547 and Township Road 31; quadrangle 2, lot 15; T. 3 N., R. 24 W.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; friable; common fine roots; about 10 percent coarse fragments; medium acid; abrupt wavy boundary.

Bt1—11 to 21 inches; brown (10YR 5/3) loam; many medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; few fine roots; pockets of gravelly sandy loam; common distinct dark grayish brown (10YR 4/2) clay films and coatings on faces of peds; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

Bt2—21 to 26 inches; grayish brown (10YR 5/2) loam; common medium faint brown (10YR 5/3) and gray (10YR 5/1) and few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films and coatings on faces of peds; few very dark grayish brown (10YR 3/2) krotovinas; few fine very dark gray (10YR 3/1) stains of iron and manganese oxide; about 8 percent coarse fragments; slightly acid; clear wavy boundary.

Bt3—26 to 34 inches; grayish brown (10YR 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and common medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct grayish brown (10YR 5/2) coatings and common distinct grayish brown (10YR 5/2) clay films on faces of peds; few very dark grayish brown (10YR 3/2) krotovinas; about 10 percent coarse fragments; slightly acid; abrupt wavy boundary.

2BC—34 to 42 inches; brown (10YR 4/3) silty clay loam; common coarse distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; many distinct grayish brown (10YR 5/2) coatings on faces of peds; few coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

2C—42 to 60 inches; brown (10YR 5/3) clay loam; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; massive; firm; few coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 50 inches. Depth to the underlying till or lacustrine sediment ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 10 percent in the Ap horizon, from 0 to 20 percent in the B horizon, and from 0 to 10 percent in the 2BC and 2C horizons.

The Ap horizon has value of 3 to 5 and chroma of 1 or 2. The Bt horizon has value of 4 to 6 and chroma of 2 to 6. It is dominantly loam, clay loam, or the gravelly analogs of those textures, but in some pedons it has thin strata of sandy loam. The 2BC and 2C horizons have value of 4 or 5 and chroma of 1 to 4. They are clay loam or silty clay loam.

Holly Series

The Holly series consists of deep, poorly drained soils that formed in loamy alluvium on flood plains. Permeability is moderate or moderately slow in the solum and moderate or moderately rapid in the substratum. Slope is 0 to 2 percent.

Holly soils commonly are adjacent to Alexandria, Bennington, Cardington, and Lobdell soils. Alexandria, Bennington, and Cardington soils have more clay in the subsoil than the Holly soils. They are on uplands. The moderately well drained Lobdell soils are in the slightly higher positions on flood plains.

Typical pedon of Holly silt loam, frequently flooded, about 2 miles west of Clarksfield, in Hartland Township; about 3,630 feet east of the intersection of Township Road 175 and County Road 186, along County Road 186, then 170 feet south; quadrangle 2, lot 18; T. 3 N., R. 21 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium and fine granular structure; friable; many fine roots; many distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; clear wavy boundary.

Bg1—10 to 15 inches; dark gray (10YR 4/1) silt loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; many fine roots; common distinct gray (10YR 5/1) coatings on faces of peds; few distinct dark brown (7.5YR 3/4) stains; slightly acid; clear wavy boundary.

Bg2—15 to 19 inches; gray (10YR 5/1) silty clay loam; few fine prominent dark grayish brown (10YR 4/6) mottles; weak medium subangular blocky structure; firm; common fine roots; common distinct dark gray (10YR 4/1) coatings on faces of peds; few distinct dark grayish brown (7.5YR 3/4) stains; slightly acid; clear wavy boundary.

Bg3—19 to 27 inches; light gray (10YR 6/1) loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak medium and fine granular structure; friable; few fine roots; common distinct light gray (10YR 6/1) coatings on faces of peds; common distinct strong brown (7.5YR 4/6) stains; neutral; clear wavy boundary.

Cg1—27 to 40 inches; light gray (10YR 6/1), stratified loam and sandy loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; friable; few fine roots; gray (10YR 5/1) root channels; common distinct strong brown (7.5YR 4/6) stains; neutral; clear wavy boundary.

Cg2—40 to 53 inches; gray (10YR 5/1) loamy sand; many medium prominent strong brown (7.5YR 5/6) mottles; single grain; loose; few fine roots; few distinct dark brown (7.5YR 3/4) stains; strata of silt loam; neutral; clear wavy boundary.

Cg3—53 to 60 inches; gray (10YR 5/1) sandy loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; few fine roots; few very dark gray (10YR 3/1) stains of iron and manganese oxide; about 8 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 44 inches. The content of coarse fragments ranges from 0 to 10 percent in the A horizon, from 0 to 15 percent in the B horizon, and from 0 to 25 percent in the C horizon.

The A horizon has chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or less. It is silt loam, loam, silty clay loam, or sandy loam. The C horizon has value of 4 to 6 and chroma of 1 or 2. It is loam, silt loam, sandy loam, loamy sand, or the gravelly analogs of those textures. It typically is stratified.

Jimtown Series

The Jimtown series consists of deep, somewhat poorly drained soils that formed in stratified outwash deposits on terraces, outwash plains, and beach ridges. Permeability is moderate in the solum and moderately rapid in the substratum. Slope is 0 to 3 percent.

Jimtown soils are similar to Haskins soils and commonly are adjacent to Bennington, Cardington, Chili, Kibbie, and Oshtemo soils. Haskins soils are underlain by moderately fine textured glacial till or lacustrine sediment. Kibbie soils have a surface layer that is slightly thicker and darker than that of the Jimtown soils and are underlain by stratified, loamy deposits. Bennington soils and the moderately well drained Cardington soils have more clay and less sand in the subsoil than the Jimtown soils and formed in glacial till. They are in the slightly higher positions on the landscape. The well drained Chili and Oshtemo soils are in the higher positions on the landscape.

Typical pedon of Jimtown loam, 0 to 3 percent slopes, about 1 mile east of Norwalk, in Norwalk Township; about 2,400 feet east and 490 feet north of the intersection of Township Roads 52 and 18; quadrangle 2; T. 4 N., R. 22 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common fine roots; few coarse fragments; neutral; abrupt smooth boundary.

Bt1—8 to 13 inches; brown (10YR 5/3) clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; common distinct grayish brown (10YR 5/2) clay films, many distinct grayish brown (10YR 5/2) coatings, and common distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; few coarse fragments; neutral; clear wavy boundary.

Bt2—13 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; many distinct grayish brown (10YR 5/2) clay films and coatings on faces of peds; few distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt3—20 to 27 inches; grayish brown (10YR 5/2) clay loam; many medium prominent yellowish brown (10YR 5/6) and common medium distinct brown (10YR 4/3) mottles; moderate coarse subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films and many distinct dark grayish brown (10YR 4/2) coatings on faces of peds; few coarse fragments; strongly acid; abrupt smooth boundary.

BC—27 to 43 inches; gray (10YR 5/1) gravelly loam; many coarse prominent yellowish brown (10YR 5/6) and common medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; friable; stratified with lenses of loamy sand; about 20 percent coarse fragments; medium acid; clear smooth boundary.

C—43 to 60 inches; brown (10YR 4/3), stratified loamy sand and gravelly sandy loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; single grain; loose; about 20 percent coarse fragments; medium acid.

The thickness of the solum ranges from 25 to 48 inches. The content of gravel ranges from 0 to 15 percent within a depth of 20 inches, from 5 to 20 percent between depths of 20 and 40 inches, and from 15 to 40 percent below a depth of 40 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The Bt horizon has value of 4 to 6 and chroma of 2 to 4. It is loam, clay loam, sandy clay loam, or the gravelly analogs of those textures. The BC and C horizons are sandy loam, loamy sand, or gravelly or very gravelly loam, sandy loam, or loamy sand.

Kibbie Series

The Kibbie series consists of deep, somewhat poorly drained soils that formed in stratified, medium textured lacustrine sediment on lake plains. Permeability is moderate. Slope is 0 to 2 percent.

The Kibbie soils in this county have a greater number of gray mottles and gray coatings on the faces of peds than is definitive for the series. Also, their subsoil does not have enough clay to qualify as an argillic horizon. These differences, however, do not alter the use or management of the soils.

Kibbie soils commonly are adjacent to Colwood, Saylesville, and Tuscola soils. The very poorly drained Colwood soils are in the slightly lower positions on the landscape. The well drained Saylesville soils are on steep side slopes in dissected areas. The moderately well drained Tuscola soils are on slight rises and in gently sloping areas adjacent to drainageways.

Typical pedon of Kibbie loam, 0 to 2 percent slopes, about 3 miles northeast of Monroeville, in Ridgefield Township; about 1,732 feet north and 576 feet west of the intersection of Township Roads 118 and 46; quadrangle 2, lot 10; T. 4 N., R. 23 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few fine roots; few coarse fragments; neutral; abrupt wavy boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) loam; many medium distinct light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; common distinct light brownish gray (10YR 6/2) clay films and dark grayish brown (10YR 4/2) organic coatings on faces of peds; dark gray (10YR 4/1) krotovinas; about 5 percent coarse fragments; neutral; clear wavy boundary.

Bt2—15 to 22 inches; brown (10YR 5/3) loam; common medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; common distinct light brownish gray (10YR 6/2) clay films and many distinct light brownish gray (10YR 6/2) coatings on faces of peds; dark gray (10YR 4/1) krotovinas; about 7 percent coarse fragments; neutral; clear wavy boundary.

Bt3—22 to 33 inches; yellowish brown (10YR 5/4) loam; many medium distinct light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few very fine roots; common distinct light brownish gray (10YR 6/2) clay films and many distinct light brownish gray (10YR 6/2) coatings on faces of peds; dark gray (10YR 4/1) krotovinas; about 10 percent coarse fragments; slight effervescence; mildly alkaline; abrupt wavy boundary.

BC—33 to 44 inches; brown (10YR 5/3) loam; common medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure parting to weak medium platy; friable; common distinct grayish brown (10YR 5/2) coatings on faces of peds; thin strata of silty clay loam; few coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C—44 to 60 inches; brown (10YR 5/3) silt loam; common coarse distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; massive; friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 48 inches. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It typically is loam but is fine sandy loam in some pedons. The B horizon has value of 4 or 5 and chroma of 3 to 6. It is loam, sandy clay loam, or silt loam. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is dominantly silt loam but in some pedons has strata of silty clay loam, loam, or fine sandy loam.

Lenawee Series

The Lenawee series consists of deep, very poorly drained soils that formed in moderately fine textured and fine textured lacustrine sediment. These soils generally are on lake plains, but in a few areas they are in depressions on till plains. Permeability is moderately slow. Slope is 0 to 2 percent.

Lenawee soils are similar to Lenawee Variant soils and commonly are adjacent to Colwood, Condit, Lenawee Variant, Shinrock, and Tiro soils. Lenawee Variant and Colwood soils are in positions on the landscape similar to those of the Lenawee soils. Lenawee Variant soils are more acid in the subsoil than the Lenawee soils, and Colwood soils have less clay and generally more sand in the subsoil. Condit soils formed in glacial till. They are in the slightly higher positions on the landscape. The moderately well drained Shinrock soils are in the higher positions on the landscape and are more sloping than the Lenawee soils. The somewhat poorly drained Tiro soils are in the slightly higher positions on the landscape and are underlain by glacial till.

Typical pedon of Lenawee silty clay loam, about 2 miles southeast of Fitchville, in Fitchville Township; about 1,240 feet east and 1,484 feet north of the intersection of U.S. Route 250 and Township Road 179; quadrangle 1, lot 40; T. 2 N., R. 21 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium and fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bg1—7 to 10 inches; dark gray (10YR 4/1) silty clay; few medium prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct black (10YR 2/1) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg2—10 to 14 inches; dark gray (10YR 4/1) silty clay; few medium prominent strong brown (7.5YR 4/6) and olive brown (2.5Y 4/4) mottles; moderate coarse prismatic structure; firm; few fine roots; common distinct dark gray (10YR 4/1) coatings on faces of peds; neutral; clear smooth boundary.

Bg3—14 to 23 inches; gray (5Y 5/1) silty clay; common medium prominent reddish brown (5YR 4/4) mottles; moderate coarse prismatic structure; firm; few fine roots; common distinct gray (5Y 5/1) coatings on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; neutral; clear smooth boundary.

Bg4—23 to 30 inches; gray (5Y 5/1) silty clay loam; many medium prominent dark brown (7.5YR 4/4) and common medium prominent yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; few fine roots; common distinct gray (5Y 5/1) coatings on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; neutral; clear smooth boundary.

BCg—30 to 35 inches; gray (10YR 5/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct gray (10YR 5/1) coatings on faces of peds; common black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C—35 to 60 inches; olive brown (2.5Y 4/4) silty clay loam stratified with silt loam and very fine sandy loam; common medium distinct dark grayish brown (10YR 4/2) mottles; massive; firm; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 55 inches. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is dominantly silty clay loam but has strata of silt loam, silty clay, or very fine sandy loam.

Lenawee Variant

The Lenawee Variant consists of deep, very poorly drained soils that formed in moderately fine textured and fine textured lacustrine sediment on lake plains. These soils once had an organic surface layer, which was destroyed by oxidation or burning after the soils were drained and cultivated. Permeability is moderately slow. Slope is 0 to 2 percent.

Lenawee Variant soils are similar to Lenawee soils and commonly are adjacent to Carlisle, Lenawee, Linwood, and Wallkill soils. Lenawee soils are less acid in the subsoil than the Lenawee Variant soils. They are in positions on the landscape similar to those of the Lenawee Variant soils. The organic Carlisle and Linwood soils are in positions on the landscape similar to those of the Lenawee Variant soils or are lower on the landscape. Wallkill soils formed in alluvium over organic deposits. They are on flood plains.

Typical pedon of Lenawee Variant silty clay loam, about 5 miles southwest of Willard, in Richmond Township; about 4,950 feet east and 30 feet north of the intersection of Township Roads 14 and 30; quadrangle 1, lot 10; T. 1 N., R. 24 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium and fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

Bg1—8 to 16 inches; dark gray (N 4/0) silty clay loam; few medium distinct light gray (10YR 6/1) mottles; weak coarse subangular blocky structure; firm; many fine roots; black (N 2/0) organic coatings on faces of peds; very strongly acid; clear smooth boundary.

Bg2—16 to 32 inches; gray (10YR 5/1) silty clay; many medium prominent strong brown (7.5YR 4/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; few reddish brown (5YR 4/4) iron stains; black (10YR 2/1) krotovinas; very strongly acid; gradual wavy boundary.

Bg3—32 to 44 inches; light gray (10YR 6/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; many reddish brown (5YR 4/4) stains; strongly acid; clear wavy boundary.

Cg1—44 to 52 inches; gray (10YR 5/1) silt loam; many medium prominent yellowish brown (10YR 5/6) and common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; strongly acid; clear wavy boundary.

Cg2—52 to 60 inches; gray (10YR 5/1) silt loam; many medium prominent yellowish brown (10YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; few reddish brown (5YR 4/4) iron stains; black (10YR 2/1) krotovinas; few coarse fragments; slightly acid.

The thickness of the solum ranges from 20 to 45 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 mainly silty clay loam or silty clay, but in some pedons it has thin strata of silt loam. 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 2. It is silt loam, silty clay loam, or loam, and in some pedons it is stratified.

Linwood Series

The Linwood series consists of deep, very poorly drained soils that formed in organic material over loamy lacustrine sediment. These soils are in bogs on lake plains. Permeability is moderately slow to moderately rapid in the organic layers and is moderate or moderately slow in the substratum. Slope is 0 to 2 percent.

Linwood soils commonly are adjacent to Carlisle, Colwood, and Lenawee Variant soils. The organic Carlisle soils are more than 51 inches deep to mineral material. Colwood and Lenawee Variant soils do not have organic layers. They are in positions on the landscape similar to those of the Linwood soils.

Typical pedon of Linwood muck, about 3 miles south of Willard, in Richmond Township; about 1,810 feet south and 330 feet west of the intersection of State Route 103 and Township Road 220; quadrangle 1, lot 20; T. 1 N., R. 24 W.

Op—0 to 10 inches; sapric material (muck), black (10YR 2/1) broken face and rubbed; less than 5 percent fiber rubbed or unrubbed; weak fine granular structure; very friable; common fine roots; strongly acid; clear wavy boundary.

Oa1—10 to 19 inches; sapric material (muck), dark reddish brown (5YR 3/3) broken face, dark reddish brown (5YR 2.5/2) rubbed; about 25 percent fiber, less than 5 percent rubbed; weak thick platy structure; friable; strongly acid; clear wavy boundary.

Oa2—19 to 29 inches; sapric material (muck), dark brown (10YR 3/3) broken face, very dark grayish brown (10YR 3/2) rubbed; about 60 percent fiber, 10 percent rubbed; massive; friable; strongly acid; gradual wavy boundary.

2Cg1—29 to 34 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark brown (10YR 3/3) mottles; massive; firm; slightly acid; abrupt smooth boundary.

2Cg2—34 to 55 inches; gray (10YR 5/1) silt loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; neutral; clear wavy boundary.

2Cg3—55 to 60 inches; gray (10YR 5/1) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; slight effervescence; mildly alkaline.

The thickness of the O horizon ranges from 16 to 51 inches. Some pedons have layers of hemic material that have a combined thickness of less than 10 inches.

The surface tier has chroma of 0 to 3, broken face and rubbed. After rubbing, it has less than 5 percent fiber. The subsurface tiers have hue of 5YR to 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3, broken face and rubbed. The 2C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam to silty clay loam.

Lobdell Series

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

Lobdell soils commonly are adjacent to Alexandria, Cardington, Orrville, and Tioga soils. Alexandria and Cardington soils have more clay and less sand in the subsoil than the Lobdell soils. They are in the higher positions on till plains. The somewhat poorly drained Orrville soils are in the slightly lower positions on flood plains. The well drained Tioga soils are in the slightly higher positions on flood plains and are adjacent to streams.

Typical pedon of Lobdell silt loam, frequently flooded, about 3 miles northeast of New London, in New London Township; about 3,464 feet north and 824 feet east of the intersection of Township Roads 183 and 42; quadrangle 2, lot 19; T. 2 N., R. 20 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium and fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

BA—9 to 14 inches; brown (10YR 4/3) silt loam; weak medium and fine subangular blocky structure; friable; many fine roots; few faint dark grayish brown (10YR 4/2) organic coatings on faces of peds; neutral; clear smooth boundary.

Bw1—14 to 19 inches; brown (10YR 5/3) silt loam; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common fine roots; dark grayish brown (10YR 4/2) wormcasts; neutral; clear smooth boundary.

Bw2—19 to 25 inches; brown (10YR 5/3) silt loam; many fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; common fine roots; few brown (10YR 4/3) wormcasts; neutral; clear smooth boundary.

Bw3—25 to 39 inches; dark brown (7.5YR 4/4) silt loam; common coarse prominent light brownish gray (10YR 6/2) and few medium distinct reddish brown (5YR 4/4) mottles; weak coarse prismatic structure; friable; strata of loam at a depth of 28 to 30 inches; few fine roots; few faint dark brown (7.5YR 4/4) coatings on faces of peds; few very dark brown (10YR 2/2) stains of iron and manganese oxide; neutral; clear smooth boundary.

C1—39 to 43 inches; light brownish gray (10YR 6/2) loam; many medium distinct brown (7.5YR 4/4) and few fine prominent strong brown (7.5YR 5/8) mottles; massive; few fine roots; few very dark brown (10YR 2/2) stains of iron and manganese oxide; neutral; abrupt smooth boundary.

C2—43 to 60 inches; light brownish gray (10YR 6/2) sandy loam; common coarse prominent reddish brown (5YR 4/3) and many medium prominent brown (7.5YR 5/4) mottles; massive; friable; slightly acid.

The thickness of the solum ranges from 24 to 50 inches. The content of coarse fragments ranges from 0 to 5 percent in the Ap horizon and from 0 to 15 percent in the B and C horizons.

The A horizon has value of 3 or 4 and chroma of 1 to 3. The B horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It commonly is silt loam or loam, but in some pedons it has strata of sandy loam, fine sandy loam, clay loam, or silty clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 6. It commonly is sandy loam, silt loam, loam, clay loam, or fine sand. In some pedons it has thin layers of gravelly or stony material below a depth of 40 inches. It is highly stratified to relatively uniform.

Lordstown Series

The Lordstown series consists of moderately deep, well drained soils on uplands. These soils formed in medium textured and moderately coarse textured glacial till and in material weathered from sandstone bedrock, which is at a depth of 20 to 40 inches. Permeability is moderate. Slope is 2 to 6 percent.

Lordstown soils commonly are adjacent to Bennington, Cardington, Haskins, and Mitiwanga soils. The somewhat poorly drained Bennington and Haskins soils and the moderately well drained Cardington soils are more than 40 inches deep over bedrock. Bennington and Haskins soils are in the lower positions on the landscape. Cardington soils are in positions on the landscape similar to those of the Lordstown soils. The somewhat poorly drained Mitiwanga soils are in the lower positions on the landscape and on the broader slopes.

Typical pedon of Lordstown loam, 2 to 6 percent slopes, about 4 miles northeast of Norwalk, in Townsend Township; about 2,310 feet east and 1,898 feet south of the intersection of County Road 153 and Township Road 157; quadrangle 3, lot 22; T. 4 N., R. 21 W.

Ap—0 to 10 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many fine roots; about 10 percent coarse fragments; strongly acid; clear wavy boundary.

Bw1—10 to 15 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; common distinct yellowish brown (10YR 5/4) coatings on faces of peds; about 10 percent coarse fragments; very strongly acid; clear wavy boundary.

Bw2—15 to 24 inches; yellowish brown (10YR 5/6) channery fine sandy loam; weak medium and coarse subangular blocky structure; friable; few fine roots; few distinct yellowish brown (10YR 5/4) clay films and common distinct yellowish brown (10YR 5/4) coatings on faces of peds; about 30 percent coarse fragments; very strongly acid; clear wavy boundary.

R—24 inches; brown (10YR 4/3), hard sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of coarse fragments ranges from 5 to 15 percent in the Ap horizon and from 10 to 30 percent in the B horizon.

The Ap horizon has chroma of 2 to 4. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is loam or fine sandy loam in the fine-earth fraction.

Millsdale Series

The Millsdale series consists of moderately deep, very poorly drained soils that formed in moderately fine textured and fine textured, water-modified glacial till that is 20 to 40 inches deep over limestone. These soils are on uplands. Permeability is moderately slow. Slope is 0 to 2 percent.

Millsdale soils are similar to Fries soils and commonly are adjacent to Castalia, Milton, Pewamo, and Prout soils. Fries soils and the somewhat poorly drained Prout soils are underlain by shale. Prout soils are in the slightly higher positions on the landscape. The well drained Castalia and Milton soils are on slight rises and knolls. The deep Pewamo soils are in positions on the landscape similar to those of the Millsdale soils.

Typical pedon of Millsdale silty clay loam, about 2 miles south of Bellevue, in Lyme Township; about 2,640 feet north and 40 feet west of the intersection of Township Roads 22 and 23; quadrangle 4, lot 3; T. 4 N., R. 24 W.

Ap—0 to 11 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium and fine granular structure; friable; few fine roots; neutral; abrupt wavy boundary.

Btg1—11 to 16 inches; dark gray (10YR 4/1) silty clay loam; few fine prominent olive brown (2.5Y 4/4) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct dark gray (10YR 4/1) clay films, many distinct dark gray (10YR 4/1) coatings, and few distinct black (10YR 2/1) organic coatings on faces of peds; black (10YR 2/1) krotovinas; few coarse fragments; neutral; clear wavy boundary.

Btg2—16 to 24 inches; gray (10YR 5/1) silty clay loam; many medium distinct dark yellowish brown (10YR 4/4) and few medium prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct dark gray (10YR 4/1) clay films and many distinct gray (10YR 5/1) coatings on faces of peds; black (10YR 2/1) krotovinas; few coarse fragments; neutral; abrupt wavy boundary.

2R—24 inches; hard limestone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of coarse fragments ranges from 0 to 15 percent in the solum.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. It is silty clay loam, silty clay, clay, or clay loam.

Milton Series

The Milton series consists of moderately deep, well drained soils on bedrock-controlled uplands. These soils formed in moderately fine textured and fine textured glacial till. They are underlain by limestone bedrock at a depth of 20 to 40 inches. Permeability is moderate or moderately slow. Slope is 2 to 6 percent.

Milton soils commonly are adjacent to Blount, Millsdale, and Pewamo soils. The somewhat poorly drained Blount soils and the very poorly drained Millsdale and Pewamo soils are in the lower positions on the landscape, at the base of slopes, and along drainageways.

Typical pedon of Milton silt loam, 2 to 6 percent slopes, about 5 miles south of Bellevue, in Sherman Township; about 330 feet east and 330 feet south of the intersection of State Routes 547 and 4; quadrangle 3, lot 18; T. 3 N., R. 24 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; common fine roots; few till pebbles; neutral; abrupt smooth boundary.

Bt1—8 to 15 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; few fine roots; few distinct yellowish brown (10YR 5/4) clay films and common distinct yellowish brown (10YR 5/4) coatings on faces of peds; few distinct dark brown (10YR 3/3) wormcasts; few till pebbles; neutral; clear wavy boundary.

Bt2—15 to 20 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; strong medium angular blocky structure; firm; few fine roots; many distinct dark brown (10YR 4/3) clay films on faces of peds; about 5 percent till pebbles; neutral; clear wavy boundary.

Bt3—20 to 27 inches; brown (10YR 4/3) clay loam; common medium faint dark yellowish brown (10YR 4/4) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few distinct brown (10YR 4/3) clay films and few distinct dark grayish brown (10YR 4/2) coatings on faces of peds; common yellow (10YR 7/8), weathered limestone remnants; about 5 percent till pebbles; slight effervescence; mildly alkaline; abrupt wavy boundary.

2R—27 inches; limestone bedrock.

The thickness of the solum, or the depth to bedrock, ranges from 20 to 40 inches. It can vary considerably within short distances. Tongues of clayey material extend into partially weathered limestone.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam, clay loam, or silty clay.

Miner Series

The Miner series consists of deep, very poorly drained soils on till plains. These soils formed in moderately fine textured and fine textured glacial till that is low in content of lime. Permeability is slow. Slope is 0 to 2 percent.

Miner soils are similar to Condit soils and commonly are adjacent to Bennington, Cardington, and Condit soils. The somewhat poorly drained Bennington soils and the moderately well drained Cardington soils are in the higher positions on the landscape and are more sloping than the Miner soils. Condit soils have a surface layer that is thinner or lighter in color than that of the Miner soils. They are in positions on the landscape similar to those of the Miner soils.

Typical pedon of Miner silty clay loam, about 2 miles north of Wakeman, in Wakeman Township; about 1,240 feet west and 750 feet south of the intersection of State Route 60 and Township Road 192; quadrangle 2, lot 42; T. 4 N., R. 24 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; friable; many fine roots; few coarse fragments; slightly acid; clear smooth boundary.

Btg1—8 to 13 inches; dark gray (10YR 4/1) silty clay; common medium prominent strong brown (7.5YR 5/6) and few medium distinct dark brown (7.5YR 4/4) mottles; weak medium and fine subangular blocky structure; firm; common fine roots; common distinct dark gray (10YR 4/1) clay films and very dark gray (10YR 3/1) organic coatings on faces of peds; few distinct reddish brown (5YR 4/4) stains; few coarse fragments; slightly acid; clear wavy boundary.

Btg2—13 to 22 inches; gray (10YR 5/1) silty clay; many medium prominent yellowish brown (10YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct dark gray (10YR 4/1) clay films and many distinct gray (10YR 5/1) coatings on faces of peds; few distinct reddish brown (5YR 4/4) stains; very dark gray (10YR 3/1) krotovinas; few coarse fragments; slightly acid; clear wavy boundary.

Btg3—22 to 36 inches; gray (10YR 5/1) silty clay; many medium distinct dark yellowish brown (10YR 4/4) and common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct gray (10YR 5/1) clay films and coatings on faces of peds; few distinct black (10YR 2/1) stains of iron and manganese oxide; very dark gray (10YR 3/1) krotovinas; few coarse fragments; slightly acid; gradual wavy boundary.

BC—36 to 58 inches; gray (10YR 5/1) silty clay loam; many medium distinct dark yellowish brown (10YR 4/4) and common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; common distinct gray (10YR 5/1) coatings on faces of peds; very dark gray (10YR 3/1) krotovinas; few coarse fragments; slightly acid; gradual wavy boundary.

C—58 to 60 inches; brown (10YR 4/3) silty clay loam; common coarse distinct yellowish brown (10YR 5/6) and common medium distinct gray (10YR 5/1) coatings on vertical seams; massive; firm; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to 60 inches. The content of coarse fragments is 0 to 2 percent in the A horizon and 2 to 10 percent in the B and C horizons.

The Ap horizon has chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay, clay, or silty clay loam. The C horizon has value of 4 or 5 and chroma of 1 to 4. It is silty clay loam or clay loam.

Mitiwanga Series

The Mitiwanga series consists of moderately deep, somewhat poorly drained soils on sandstone ridges in the uplands. These soils formed in medium textured and moderately fine textured glacial drift over sandstone. Permeability is moderate. Slope is 1 to 4 percent.

Mitiwanga soils are similar to Prout soils and commonly are adjacent to Bennington, Cardington, Haskins, and Lordstown soils. Prout soils are underlain by shale bedrock. The deep, somewhat poorly drained Bennington and Haskins soils are in the lower positions on the landscape. The moderately well drained Cardington soils are in the slightly higher positions on the landscape. The well drained Lordstown soils are in the higher positions on the landscape or on the narrower slopes.

Typical pedon of Mitiwanga silt loam, 1 to 4 percent slopes, about 3 miles northwest of Wakeman, in Townsend Township; about 1,566 feet west and 30 feet south of the intersection of County Road 59 and Township Road 202; quadrangle 2, lot 12; T. 4 N., R. 21 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; common medium and fine roots; few coarse fragments; medium acid; clear smooth boundary.

Bt1—10 to 15 inches; brown (10YR 5/3) clay loam; common medium distinct light brownish gray (10YR 6/2) and few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; few distinct light brownish gray (10YR 6/2) clay films and many distinct light brownish gray (10YR 6/2) coatings on faces of peds; few coarse fragments; very strongly acid; clear wavy boundary.

Bt2—15 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct gray (10YR 5/1) and few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; many distinct dark grayish brown (10YR 4/2) clay films and many distinct dark grayish brown (10YR 4/2) coatings on faces of peds; few distinct black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; very strongly acid; clear wavy boundary.

Bt3—23 to 30 inches; strong brown (7.5YR 5/6) clay loam; many medium prominent gray (10YR 5/1) and common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; many distinct dark grayish brown (10YR 4/2) clay films and many distinct dark grayish brown (10YR 4/2) coatings on faces of peds; many distinct black (10YR 2/1) stains of iron and manganese oxide; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

2R—30 inches; fractured sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of coarse fragments ranges from 2 to 25 percent in the Ap and B horizons. The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It generally is loam, silt loam, clay loam, or silty clay loam, but sandy and channery material is common directly above the bedrock.

Orrville Series

The Orrville series consists of deep, somewhat poorly drained soils that formed in moderately coarse textured and medium textured alluvium on flood plains. Permeability is moderate in the solum and moderate or moderately rapid in the substratum. Slope is 0 to 2 percent.

Orrville soils commonly are adjacent to Bennington, Cardington, Haskins, Lobdell, and Tioga soils. Bennington, Cardington, and Haskins soils are on uplands. Bennington and Cardington soils formed in glacial till, and Haskins soils formed in outwash over glacial till. The moderately well drained Lobdell soils and the well drained Tioga soils are slightly higher on the flood plains than the Orrville soils or are closer to streams.

Typical pedon of Orrville silt loam, frequently flooded, about 7 miles southwest of Monroeville, in Sherman Township; about 2,144 feet south and 42 feet east of the intersection of County Roads 64 and 30; quadrangle 1, lot 25; T. 3 N., R. 24 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

Bw—9 to 17 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; common distinct dark grayish brown (10YR 4/2) coatings and dark grayish brown (10YR 4/2) organic coatings on faces of peds; slightly acid; clear wavy boundary.

Bg1—17 to 23 inches; grayish brown (10YR 5/2) silt loam; many medium prominent strong brown (7.5YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium and coarse subangular blocky structure; friable; few fine roots; common distinct grayish brown (10YR 5/2) coatings on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; slightly acid; clear wavy boundary.

Bg2—23 to 34 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct dark yellowish brown (10YR 4/4) and few medium prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; friable; few fine roots; common distinct dark grayish brown (10YR 4/2) coatings on faces of peds; common black (10YR 2/1) stains of iron and manganese oxide; slightly acid; clear wavy boundary.

Cg1—34 to 42 inches; grayish brown (10YR 5/2) loam; common medium distinct dark yellowish brown (10YR 4/4) and few medium prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; friable; few fine roots; common distinct dark grayish brown (10YR 4/2) coatings on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; slightly acid; clear smooth boundary.

Cg2—42 to 60 inches; dark grayish brown (10YR 4/2) sandy loam; common medium faint brown (10YR 4/3) and few medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 14 percent coarse fragments; neutral.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is silt loam or loam. The C horizon has hue of 10YR or 2.5Y and chroma of 2 to 4. It is silt loam, loam, or sandy loam.

Oshtemo Series

The Oshtemo series consists of deep, well drained soils that formed in moderately coarse textured and coarse textured material and in the underlying sand and gravelly sand. These soils are on beach ridges. Permeability is moderately rapid in the solum and very rapid in the substratum. Slope is 2 to 6 percent.

Oshtemo soils commonly are adjacent to Chili, Haskins, Jimtown, Pewamo, and Spinks soils. Chili soils have more clay in the subsoil than the Oshtemo soils. They are in positions on the landscape similar to those of the Oshtemo soils. The somewhat poorly drained Jimtown and Haskins soils are in the lower positions on the landscape, at the base of beach ridges. The very poorly drained Pewamo soils are in nearly level areas at the base of beach ridges. Spinks soils have more sand and less clay in the solum than the Oshtemo soils. They are in the slightly higher positions on beach ridges.

Typical pedon of Oshtemo fine sandy loam, 2 to 6 percent slopes, about 3 miles south of Norwalk, in Bronson Township; about 824 feet north and 576 feet east of the intersection of State Route 61 and County Road 129; quadrangle 3, lot 2; T. 3 N., R. 22 W.

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

Bt1—10 to 16 inches; brown (7.5YR 4/4) gravelly coarse sandy loam; weak medium and fine granular structure; very friable; common fine roots; common distinct dark brown (10YR 4/3) clay films on faces of peds; about 20 percent pebbles; slightly acid; gradual smooth boundary.

Bt2—16 to 22 inches; brown (7.5YR 4/4) gravelly coarse sandy loam; weak medium and fine granular structure; very friable; few fine roots; common distinct brown (7.5YR 4/4) clay bridges on faces of peds and between sand grains; about 25 percent pebbles; slightly acid; gradual smooth boundary.

Bt3—22 to 35 inches; dark yellowish brown (10YR 4/4) gravelly coarse sandy loam; few medium distinct dark yellowish brown (10YR 4/6) mottles; weak medium and fine granular structure; very friable; few fine roots; common distinct brown (10YR 4/3) clay bridges between sand grains; about 30 percent pebbles; slightly acid; gradual smooth boundary.

BC—35 to 41 inches; dark brown (7.5YR 3/4) gravelly coarse sandy loam; few medium distinct strong brown (7.5YR 4/6) mottles; weak medium and fine granular structure; very friable; few fine roots; few distinct dark brown (10YR 3/3) clay bridges between sand grains; about 30 percent pebbles; neutral; gradual smooth boundary.

C—41 to 60 inches; brown (10YR 4/3) very gravelly coarse sand; single grain; loose; few fine roots; stratified in the lower part; about 45 percent pebbles; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 66 inches. The content of coarse fragments ranges from 1 to 30 percent in the Ap and Bt horizons.

The Ap horizon has value of 4 or 5 and 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 sandy loam, gravelly sandy loam, sandy clay loam, or gravelly coarse sandy loam. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is stratified very gravelly coarse sand, sand, or extremely gravelly sand.

Otisville Series

The Otisville series consists of deep, excessively drained soils that formed in coarse textured glacial outwash on beach ridges. Permeability is rapid. Slope is 2 to 6 percent.

Otisville soils commonly are adjacent to Fries, Haskins, Pewamo, and Prout soils, which are at the base of the beach ridges. Fries and Pewamo soils are very poorly drained. Haskins and Prout soils are somewhat poorly drained. Fries and Prout soils have shale bedrock at a depth of 20 to 40 inches.

Typical pedon of Otisville gravelly sandy loam, 2 to 6 percent slopes, about 1 mile north of Monroeville, in Ridgefield Township; about 2,640 feet north of the intersection of State Route 99 and U.S. Route 20, along State Route 99, then 82 feet west; quadrangle 3, lot 6; T. 4 N., R. 23 W.

Ap—0 to 9 inches; dark brown (7.5YR 3/2) gravelly sandy loam, pinkish gray (7.5YR 6/2) dry; weak fine granular structure; very friable; few fine roots; about 20 percent coarse fragments, dominantly shale; neutral; abrupt smooth boundary.

Bw1—9 to 15 inches; brown (7.5YR 5/4) gravelly loamy sand; weak medium and fine granular structure; very friable; few fine roots; common distinct dark brown (7.5YR 4/4) coatings on faces of peds; about 30 percent coarse fragments, dominantly shale; neutral; clear smooth boundary.

Bw2—15 to 24 inches; strong brown (7.5YR 4/6) very gravelly loamy sand; weak medium and fine granular structure; very friable; few faint strong brown (7.5YR 4/6) coatings on faces of peds; about 50 percent coarse fragments, dominantly shale; very strongly acid; clear smooth boundary.

Bw3—24 to 36 inches; strong brown (7.5YR 4/6) very gravelly loamy sand; weak fine granular structure; very friable; few faint strong brown (7.5YR 4/6) coatings on faces of peds; about 50 percent coarse fragments, dominantly shale; very strongly acid; clear smooth boundary.

C1—36 to 54 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; few medium distinct dark brown (7.5YR 4/4) and few fine distinct strong brown (7.5YR 5/8) mottles; single grain; loose; about 30 percent coarse fragments, dominantly shale; very strongly acid; clear smooth boundary.

C2—54 to 60 inches; dark yellowish brown (10YR 4/4) very gravelly loamy sand; single grain; loose; about 50 percent coarse fragments, dominantly shale; very strongly acid.

The thickness of the solum ranges from 20 to 36 inches. The content of coarse fragments, mainly pebbles and some cobblestones, ranges from 15 to 35 percent in the Ap horizon, from 20 to 50 percent in the individual layers of the B horizon, and from 30 to 70 percent in the C horizon. It averages more than 35 percent in the B horizon. The content of cobblestones ranges from 0 to 5 percent in the Ap horizon and from 0 to 10 percent in the B and C horizons.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR and chroma of 3 to 6. It is loamy sand to coarse sand in the fine-earth fraction. The C horizon has hue of 7.5YR or 10YR and value of 4 or 5.

Pandora Series

The Pandora series consists of deep, poorly drained soils that formed in moderately fine textured and fine textured glacial till on till plains. Permeability is moderately slow. Slope is 0 to 2 percent.

Pandora soils are similar to Condit soils and commonly are adjacent to Blount and Glynwood soils. Condit soils are more acid in the subsoil than the Pandora soils. The somewhat poorly drained Blount soils and the moderately well drained Glynwood soils are in the higher positions on the landscape.

Typical pedon of Pandora silty clay loam, about 7 miles south of Bellevue, in Sherman Township; about 1,280 feet west and 140 feet south of the intersection of County Road 16 and Township Road 205; quadrangle 4, lot 23; T. 3 N., R. 24 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak medium and fine granular structure; friable; common fine roots; few coarse fragments; neutral; clear wavy boundary.

BE—7 to 14 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak medium and fine subangular blocky structure; friable; many fine roots; few distinct grayish brown (10YR 5/2) coatings on faces of peds; few coarse fragments; neutral; clear wavy boundary.

Btg1—14 to 25 inches; dark gray (5Y 4/1) silty clay; common medium prominent strong brown (7.5YR 4/6) and common fine prominent dark brown (7.5YR 3/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films and coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; dark grayish brown (10YR 4/2) krotovinas; few coarse fragments; neutral; clear wavy boundary.

Btg2—25 to 37 inches; gray (5Y 5/1) silty clay; common medium prominent yellowish brown (10YR 5/6) and common medium prominent brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films and coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; dark grayish brown (10YR 4/2) krotovinas; few coarse fragments; neutral; clear wavy boundary.

BC—37 to 49 inches; gray (5Y 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and brown (10YR 4/3) mottles; moderate coarse subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; neutral; clear wavy boundary.

C—49 to 60 inches; brown (10YR 4/3) silty clay loam; common medium distinct gray (10YR 5/1) and few medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; gray (10YR 5/1) coatings on vertical seams; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges, by volume, from 0 to 5 percent throughout the profile.

The Ap horizon has chroma of 1 or 2. The Btg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay, silty clay loam, clay, or 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.

Pewamo Series

The Pewamo series consists of deep, very poorly drained soils that formed in lacustrine sediment and glacial till on lake plains and till plains. Permeability is moderately slow. Slope is 0 to 2 percent.

The Pewamo soils in this county are taxadjuncts because the subsoil does not have enough clay to qualify as an argillic horizon. This difference, however, does not alter the use or management of the soils.

Pewamo soils are similar to Lenawee and Pandora soils and commonly are adjacent to Bennington, Fries, and Oshtemo soils. Lenawee and Pandora soils have a surface layer that is thinner or lighter colored than that of the Pewamo soils. The somewhat poorly drained Bennington soils are in the higher positions on the landscape. Fries soils have shale bedrock at a depth of 20 to 40 inches. They are in positions on the landscape similar to those of the Pewamo soils. The well drained Oshtemo soils are in the higher positions on beach ridges.

Typical pedon of Pewamo silty clay loam, about 3 miles southwest of Monroeville, in Lyme Township; about 2,640 feet west of the intersection of State Route 547 and Township Road 32, along State Route 547, then 820 feet north; quadrangle 1, lot 7; T. 4 N., R. 24 W.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium and fine granular structure; friable; many medium roots; medium acid; abrupt smooth boundary.

Bg1—12 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; common medium roots; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; few coarse fragments; slightly acid; clear smooth boundary.

Bg2—16 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and few medium prominent dark yellowish brown (10YR 4/6) mottles; strong medium prismatic structure parting to moderate coarse subangular blocky; firm; few fine roots; common distinct dark gray (10YR 4/1) coatings on vertical faces of peds; few coarse fragments; few very dark gray (10YR 2/2) stains of iron and manganese oxide; neutral; clear smooth boundary.

Bg3—33 to 46 inches; gray (10YR 5/1) clay loam; many coarse prominent yellowish brown (10YR 5/6) and many medium prominent dark yellowish brown (10YR 4/6) mottles; strong medium prismatic structure; firm; few fine roots; common distinct gray (10YR 5/1) coatings on vertical faces of peds; few shale fragments; neutral; clear smooth boundary.

BC—46 to 59 inches; gray (10YR 5/1) clay loam; many medium prominent yellowish brown (10YR 5/6) and few medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium platy structure; firm; about 5 percent shale fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—59 to 63 inches; brown (10YR 4/3) clay loam; many medium distinct dark grayish brown (10YR 4/2) and few medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few shale fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 70 inches. The content of coarse fragments ranges from 0 to 15 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, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay, clay, clay loam, or silty clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 3. It is silty clay loam or clay loam.

Pinnebog Series

The Pinnebog series consists of deep, very poorly drained soils that formed in partially decomposed organic material in bogs on lake plains. Permeability is moderately rapid to moderately slow. Slope is 0 to 2 percent.

Pinnebog soils are similar to Carlisle soils and commonly are adjacent to Carlisle and Linwood soils. Carlisle and Linwood soils are in positions on the landscape similar to those of the Pinnebog soils. They have less fibrous material than the Pinnebog soils. Also, Linwood soils are underlain by mineral material within 51 inches of the surface.

Typical pedon of Pinnebog muck, about 3 miles southwest of Willard, in Richmond Township; about 2,804 feet north and 4,784 feet east of the intersection of Township Roads 86 and 30; quadrangle 1, lot 21; T. 1 N., R. 24 W.

Oa—0 to 4 inches; sapric material (muck), dark reddish brown (5YR 3/2) broken face, black (5YR 2.5/1) rubbed; about 60 percent fiber, 5 percent rubbed; weak fine granular structure; very friable; common medium and fine roots; extremely acid; clear smooth boundary.

Oe—4 to 12 inches; hemic material (mucky peat), dark reddish brown (5YR 3/3) broken face, black (10YR 2/1) rubbed; about 90 percent fiber, 20 percent rubbed; weak medium platy structure; very friable; few medium and fine roots; extremely acid; clear smooth boundary.

O'a—12 to 20 inches; sapric material (muck), dark brown (7.5YR 3/2) broken face, black (10YR 2/1) rubbed; about 50 percent fiber, 5 percent rubbed; massive; friable; few medium and fine roots; very strongly acid; gradual smooth boundary.

O'e—20 to 32 inches; hemic material (mucky peat), dark brown (7.5YR 3/2) broken face, black (10YR 2/1) rubbed; about 80 percent fiber, 40 percent rubbed; massive; friable; few woody fragments; medium acid; gradual smooth boundary.

O"a—32 to 60 inches; sapric material (muck), very dark grayish brown (10YR 3/2) broken face, black (N 2/0) rubbed; about 40 percent fiber, 10 percent rubbed; massive; friable; slightly acid.

The organic material has hue of 5YR to 10YR and value and chroma of 1 to 3. The thickness of the hemic material below the surface tier ranges from 10 to 26 inches.

Prout Series

The Prout series consists of moderately deep, somewhat poorly drained soils that formed in medium textured and moderately fine textured glacial till or lacustrine deposits that have shale fragments. These soils are underlain by shale. They are on bedrock-controlled uplands. Permeability is moderately slow. Slope is 0 to 2 percent.

Prout soils commonly are adjacent to Bennington, Fries, and Pewamo soils. The deep Bennington soils are in positions on the landscape similar to those of the

Prout soils. The very poorly drained Fries and Pewamo soils are in the lower positions on the landscape and along drainageways.

Typical pedon of Prout silt loam, 0 to 2 percent slopes, about 2 miles west of Monroeville, in Ridgefield Township; about 1,980 feet south and 490 feet east of the intersection of State Route 547 and Township Road 27; quadrangle 4, lot 18; T. 4 N., R. 23 W.

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

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct light brownish gray (10YR 6/2) clay films and many distinct grayish brown (10YR 5/2) coatings on faces of peds; few coarse fragments; very strongly acid; clear wavy boundary.

Bt2—15 to 20 inches; light brownish gray (10YR 6/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) and common medium faint gray (10YR 6/1) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct light brownish gray (10YR 6/2) clay films and coatings on faces of peds; about 10 percent coarse fragments, dominantly shale; very strongly acid; clear wavy boundary.

2BC—20 to 26 inches; light brownish gray (10YR 6/2) very shaly silty clay loam; common medium prominent strong brown (7.5YR 5/6) and common medium faint gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct light brownish gray (10YR 6/2) clay films and common distinct light brownish gray (10YR 6/2) coatings on faces of peds; about 40 percent coarse fragments; very strongly acid; clear wavy boundary.

2Cr—26 inches; yellowish brown (10YR 5/6), soft shale bedrock.

The thickness of the solum and the depth to paralithic or lithic contact range from 20 to 40 inches. The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The Bt horizon has value of 4 to 6 and chroma of 2 to 6. It is silty clay loam, clay loam, or the shaly analogs of those textures. The 2BC or 2C horizon has value of 4 to 6 and chroma of 2 to 4. It is very shaly silty clay loam or very shaly clay loam. The bedrock is soft, weathered shale in the upper part and grades to soft, unweathered shale with increasing depth.

Saylesville Series

The Saylesville series consists of deep, well drained soils that formed in medium textured and moderately fine textured lacustrine sediment on lake plains. Permeability is moderately slow. Slope is 25 to 40 percent.

Saylesville soils are similar to Alexandria soils and commonly are adjacent to Kibbie, Orrville, Tioga, and Tuscola soils. Alexandria soils formed in glacial till. The somewhat poorly drained Kibbie and moderately well drained Tuscola soils are on lake plains. Kibbie soils are nearly level. Orrville and Tioga soils have less clay and more sand in the subsoil than the Saylesville soils. They are on flood plains.

Typical pedon of Saylesville silt loam, 25 to 40 percent slopes, about 1 mile west of Norwalk, in Ridgefield Township; about 576 feet east and 494 feet south of the intersection of Township Roads 46 and 123; quadrangle 2, lot 6; T. 4 N., R. 23 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak medium and fine granular structure; friable; many fine roots; medium acid; clear smooth boundary.

E—4 to 9 inches; brown (10YR 5/3) silt loam; weak medium and fine granular structure; friable; many fine roots; few faint grayish brown (10YR 5/2) organic coatings on faces of peds; strongly acid; clear smooth boundary.

Bt1—9 to 16 inches; brown (10YR 5/3) silty clay loam; few medium distinct yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 4/6) mottles; weak medium and fine subangular blocky structure; friable; many fine roots; few faint brown (10YR 5/3) clay films on faces of peds; strongly acid; abrupt smooth boundary.

Bt2—16 to 29 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 4/4) mottles; moderate coarse and medium subangular blocky structure; firm; common fine roots; few faint brown (10YR 5/3) clay films on faces of peds; medium acid; clear smooth boundary.

Bt3—29 to 39 inches; dark yellowish brown (10YR 4/4) silty clay loam; few medium distinct strong brown (7.5YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; strong coarse prismatic structure; firm; few fine roots; few faint brown (10YR 4/3) clay films on faces of peds; slightly acid; clear smooth boundary.

C1—39 to 56 inches; dark yellowish brown (10YR 4/4) silty clay loam; few medium distinct strong brown (7.5YR 4/6) and few fine distinct yellowish brown

(10YR 5/6) mottles; massive but parts to weak thick plates along bedding planes; firm; slight effervescence; mildly alkaline; clear smooth boundary.

C2—56 to 60 inches; brown (10YR 5/3) silt loam; few medium distinct yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/8) mottles; massive; firm; stratified with lenses of silty clay loam; few distinct white (10YR 8/2) coatings of calcium carbonate in partings; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 40 inches. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The E horizon has value of 4 to 6 and chroma of 2 or 3. It is silt loam, loam, or silty clay loam. The Bt horizon has hue of 10YR or 7.5YR. It is silty clay loam or silty clay. The C horizon is dominantly silt loam or silty clay loam but in some pedons has thin strata of very fine sand or silty clay.

Shinrock Series

The Shinrock series consists of deep, moderately well drained soils that formed in medium textured and moderately fine textured lacustrine sediment on lake plains. Permeability is moderately slow. Slope is 2 to 6 percent.

Shinrock soils are similar to Cardington soils and commonly are adjacent to Bennington, Cardington, Lenawee, and Tuscola soils. Bennington and Cardington soils formed in glacial till. They are in positions on till plains similar to those of the Shinrock soils. The very poorly drained Lenawee soils are in the lower areas in depressions and along drainageways. Tuscola soils have more sand and less clay in the subsoil than the Shinrock soils. They are in positions on the landscape similar to those of the Shinrock soils.

Typical pedon of Shinrock silt loam, 2 to 6 percent slopes, about 2 miles southeast of Fitchville, in Fitchville Township; about 2,062 feet north and 150 feet west of the intersection of U.S. Route 250 and Township Road 179; quadrangle 1, lot 23; T. 2 N., R. 21 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium and fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

BE—9 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; many fine roots; common distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; few coarse fragments; strongly acid; clear smooth boundary.

Bt1—16 to 22 inches; brown (10YR 5/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and few medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark yellowish brown (10YR 4/4) clay films and coatings on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt2—22 to 29 inches; dark yellowish brown (10YR 4/4) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and few medium distinct light brownish gray (10YR 6/2) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct brown (10YR 5/3) clay films and coatings on faces of peds; many black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; medium acid; clear wavy boundary.

BC—29 to 35 inches; brown (10YR 5/3) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; massive but parts to weak thick plates along bedding planes; firm; few fine roots; common distinct grayish brown (10YR 5/2) coatings on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; neutral; clear wavy boundary.

C1—35 to 52 inches; dark yellowish brown (10YR 4/4) silty clay loam that has strata of silt loam; common medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; firm; few fine roots; common distinct brown (10YR 5/3) coatings on bedding planes; common distinct light gray (10YR 7/1) coatings of calcium carbonate in partings; strong effervescence; moderately alkaline; clear wavy boundary.

C2—52 to 60 inches; brown (10YR 4/3) silty clay loam that has strata of silt loam; few medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; firm; common distinct light gray (10YR 7/1) coatings of calcium carbonate in partings; strong 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. It is silt loam or loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam or silty clay. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It commonly is silty clay loam but has strata of silt loam or fine sandy loam.

Spinks Series

The Spinks series consists of deep, well drained soils that formed in coarse textured sediment on beach ridges. Permeability is moderately rapid. Slope is 2 to 6 percent.

Spinks soils commonly are adjacent to Colwood, Kibbie, Oshtemo, and Pewamo soils. The very poorly drained Colwood and Pewamo soils and the somewhat poorly drained Kibbie soils are in the lower positions on the landscape. Oshtemo soils have more clay and less sand in the subsoil than the Spinks soils. They are on the lower ridges.

Typical pedon of Spinks loamy fine sand, 2 to 6 percent slopes, about 3 miles west of Monroeville, in Lyme Township; about 5,690 feet north of the intersection of County Road 40 and Township Road 25, along County Road 40, then 1,812 feet east; quadrangle 1, lot 32; T. 4 N., R. 24 W.

Ap—0 to 12 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; loose; many medium roots; strongly acid; abrupt smooth boundary.

E&Bt1—12 to 36 inches; yellowish brown (10YR 5/6) loamy fine sand (E); single grain; loose; common fine roots; lamellae of dark brown (7.5YR 4/4) loamy fine sand (Bt1) 2 to 4 inches thick; weak fine granular structure; very friable; clay films bridging sand grains in the lamellae; medium acid; gradual smooth boundary.

E&Bt2—36 to 60 inches; yellowish brown (10YR 5/6) loamy fine sand (E); single grain; loose; few fine roots; lamellae of dark brown (7.5YR 4/4) loamy fine sand (Bt2) ½ inch to 2 inches thick; weak fine granular structure; very friable; clay films bridging sand grains in the lamellae; neutral.

The thickness of the solum ranges from 50 to more than 60 inches. The Ap horizon has value of 3 to 5 and chroma of 3 or 4. The E part of the E&Bt horizon has value of 5 or 6 and chroma of 4 to 6. It is loamy fine sand, loamy sand, or fine sand. The B part has value of 4 or 5 and chroma of 4 to 6. The lamellae range from ⅛ inch to 5 inches in thickness and are 5 to 10 inches apart (fig. 15).

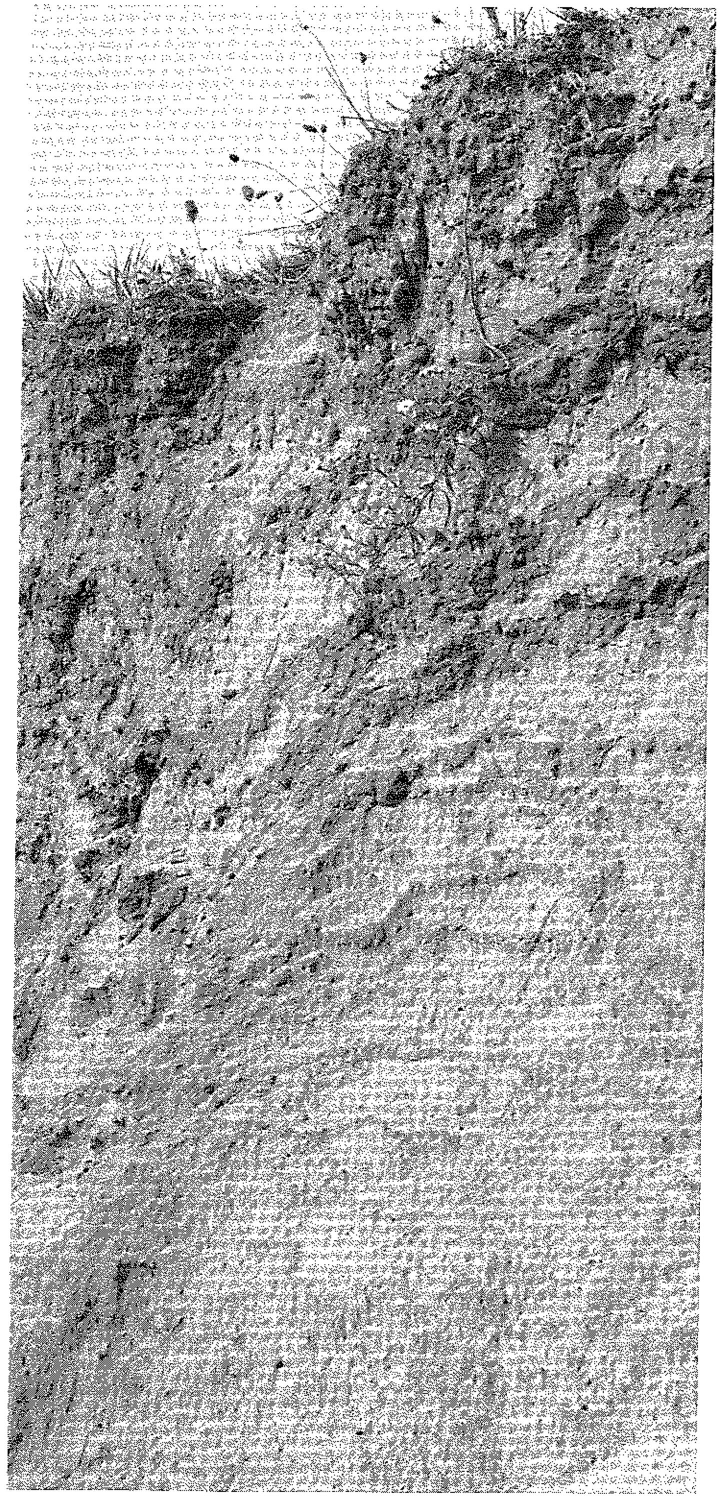

Figure 15.—Profile of Spinks loamy fine sand, 2 to 6 percent slopes, which has horizontal bands, or lamellae. The content of clay in the bands improves the ability of the soil to retain moisture.

Tioga Series

The Tioga series consists of deep, well drained soils that formed in medium textured to coarse textured recent alluvium. These soils are on flood plains. Permeability is moderate or moderately rapid in the solum and is moderate to rapid in the substratum. Slope is 0 to 2 percent.

Tioga soils commonly are adjacent to Alexandria, Brecksville, Lobdell, and Saylesville soils. Alexandria, Brecksville, and Saylesville soils have less sand and more clay in the subsoil than the Tioga soils. They are in the higher positions on uplands. The moderately well drained Lobdell soils are in the lower positions on flood plains or in areas on the flood plains that receive runoff from the adjacent uplands.

Typical pedon of Tioga loam, occasionally flooded, about 3 miles north of Monroeville, in Ridgefield Township; about 660 feet west of the intersection of Township Roads 116 and 118, along Township Road 118, then 164 feet north; quadrangle 2, lot 15; T. 4 N., R. 23 W.

Ap—0 to 11 inches; brown (10YR 4/3) loam, brown (10YR 5/3) dry; mixed with dark yellowish brown (10YR 4/4) subsoil material in the lower part; weak fine granular structure; friable; many fine roots; many dark grayish brown (10YR 4/2) organic coatings; few shale fragments; neutral; clear wavy boundary.

Bw—11 to 20 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; few distinct dark grayish brown (10YR 4/2) organic coatings on faces of peds; neutral; clear wavy boundary.

C1—20 to 29 inches; brown (10YR 4/3) fine sandy loam; weak medium and fine granular structure; friable; few fine roots; few faint dark grayish brown (10YR 4/2) organic coatings on faces of peds; neutral; clear wavy boundary.

C2—29 to 38 inches; brown (10YR 4/3) loam; weak fine granular structure; friable; few fine roots; neutral; clear wavy boundary.

C3—38 to 46 inches; brown (10YR 4/3) loam; common medium distinct gray (10YR 5/1) and common fine distinct dark yellowish brown (10YR 4/6) mottles; weak medium and fine granular structure; very friable; few fine roots; neutral; clear wavy boundary.

C4—46 to 53 inches; brown (10YR 4/3) loamy sand; many medium distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/6) mottles; single grain; loose; few very fine roots; slightly acid; abrupt wavy boundary.

C5—53 to 60 inches; brown (10YR 4/3) sandy loam; many medium distinct gray (10YR 5/1) and dark brown (7.5YR 3/4) mottles; massive; very friable; about 8 percent coarse fragments; medium acid.

The solum ranges from 18 to 40 inches in thickness. It has few or no coarse fragments.

The Ap horizon has value of 3 to 5 and chroma of 2 or 3. The B horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam, loam, or fine sandy loam. The C horizon has value of 4 or 5 and chroma of 2 or 4. It is loam, silt loam, sandy loam, or loamy sand.

Tiro Series

The Tiro series consists of deep, somewhat poorly drained soils on water-modified till plains. These soils formed in medium textured lacustrine sediment and a thin layer of moderately fine textured, water-sorted material, which is underlain by moderately fine textured glacial till. Permeability is slow or moderately slow. Slope is 0 to 6 percent.

Tiro soils commonly are adjacent to Cardington, Condit, and Lenawee soils. The moderately well drained Cardington soils are in the higher positions on the landscape. The poorly drained Condit soils and the very poorly drained Lenawee soils are in the lower areas in depressions and along shallow drainageways.

Typical pedon of Tiro silt loam, 0 to 2 percent slopes, about 5 miles southwest of Willard, in Richmond Township; about 5,280 feet north and 130 feet east of the intersection of Township Roads 13 and 86; quadrangle 4, lot 7; T. 1 N., R. 24 W.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and fine granular structure; friable; many fine roots; mixed with some yellowish brown (10YR 5/6) subsoil material; few coarse fragments; medium acid; clear smooth boundary.

Bt1—9 to 16 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct dark yellowish brown (10YR 4/6) and few medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; few fine roots; few distinct grayish brown (10YR 5/2) clay films and many distinct grayish brown (10YR 5/2) coatings on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt2—16 to 21 inches; brown (10YR 5/3) silty clay loam; many medium distinct light brownish gray (10YR 6/2) and dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films and brown (10YR 5/3) coatings on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt3—21 to 26 inches; brown (10YR 4/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and dark yellowish brown (10YR 4/6) mottles; moderate coarse subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films and many distinct dark grayish brown (10YR 4/2) coatings on faces of peds; common distinct black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; strongly acid; clear wavy boundary.

2Bt4—26 to 31 inches; brown (10YR 4/3) clay loam; common medium distinct light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (10YR 4/2) clay films and many distinct dark grayish brown (10YR 4/2) coatings on faces of peds; common distinct black (10YR 2/1) stains of iron and manganese oxide; about 7 percent coarse fragments; neutral; clear wavy boundary.

2BC—31 to 39 inches; brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) coatings on faces of peds; few coarse fragments; neutral; clear smooth boundary.

3C—39 to 60 inches; brown (10YR 4/3) silty clay loam; few medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; massive; firm; few coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 55 inches. The thickness of the silty lacustrine sediment ranges from 22 to 36 inches. The depth to glacial till ranges from 30 to 40 inches. The content of coarse fragments is 0 to 3 percent in the A and B horizons, 0 to 15 percent in the 2B horizon, and 2 to 10 percent in the 3C horizon.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3 Some pedons have an E horizon. This horizon is 2 to 8 inches thick. It has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 to 6. It silt loam or silty clay loam. The 2B horizon has colors similar to those of the B horizon. It is clay loam or loam. The 3C horizon has value of 4 or 5 and chroma of 2 to 4. It is loam, clay loam, or silty clay loam.

Tuscola Series

The Tuscola series consists of deep, moderately well drained soils that formed in medium textured and moderately coarse textured lacustrine and outwash deposits on lake plains and outwash plains. Permeability is moderate. Slope is 0 to 6 percent.

The Tuscola soils in this county have more sand and less clay than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Tuscola soils commonly are adjacent to Colwood, Kibbie, Oshtemo, Saylesville, and Spinks soils. The very poorly drained Colwood soils and the somewhat poorly drained Kibbie soils are in the lower areas in depressions and on flats. The well drained Oshtemo and Spinks soils are in the higher positions on the landscape. The well drained Saylesville soils are on steep side slopes along drainageways.

Typical pedon of Tuscola fine sandy loam, 0 to 2 percent slopes, about 2 miles north of Norwalk, in Norwalk Township; about 3,460 feet north of the intersection of U.S. Route 250 and Township Road 125, along U.S. Route 250, then 1,072 feet west; quadrangle 3, lot 60; T. 4 N., R. 22 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; mixed with yellowish brown (10YR 5/6) subsoil material; neutral; abrupt smooth boundary.

BE—10 to 13 inches; yellowish brown (10YR 5/6) sandy loam; common medium distinct dark yellowish brown (10YR 4/6) mottles; weak medium and fine subangular blocky structure; friable; common medium roots; common distinct brown (10YR 5/3) coatings on faces of peds; dark grayish brown (10YR 4/2) organic coatings on faces of peds; neutral; clear wavy boundary.

Bt1—13 to 17 inches; brown (10YR 5/3) sandy loam; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) mottles; weak medium and fine subangular blocky structure; friable; common medium roots; common distinct brown (10YR 4/3) coatings and clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; about 5 percent coarse fragments; neutral; clear wavy boundary.

Bt2—17 to 24 inches; yellowish brown (10YR 5/4) sandy loam; many medium distinct yellowish brown (10YR 5/6), common medium distinct dark yellowish brown (10YR 4/4), and few medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure parting to weak fine granular; friable; few fine roots; common distinct dark yellowish brown (10YR 4/4) coatings and clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; neutral; clear wavy boundary.

Bt3—24 to 35 inches; brown (10YR 4/3) loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; few fine roots; common distinct brown (10YR 4/3) coatings and clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; neutral; clear wavy boundary.

BC—35 to 41 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/6) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine roots; common distinct dark yellowish brown (10YR 4/4) coatings on faces of peds; neutral; gradual wavy boundary.

C—41 to 60 inches; brown (10YR 5/3) silt loam; many medium distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; thin strata of loamy fine sand; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 50 inches. The Ap horizon has chroma of 2 or 3. The BE and Bt horizons are loam, fine sandy loam, sandy loam, or silt loam. The BE horizon has value of 4 to 6 and chroma of 3 to 6. The Bt horizon has value of 4 to 6 and chroma of 2 to 4. The C horizon has value of 5 or 6. It is fine sandy loam, silt loam, or loamy fine sand.

Wallkill Series

The Wallkill series consists of deep, very poorly drained soils on flood plains or around the margins of organic soils adjacent to uplands. The Wallkill soils formed in medium textured mineral alluvium and in the underlying organic material, which is underlain by moderately fine textured mineral lacustrine sediment. Permeability is moderate in the mineral upper part of the profile, moderately rapid or rapid in the organic layers, and slow in the lower lacustrine material. Slope is 0 to 2 percent.

The Wallkill soils in this county contain more silt and less sand than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Wallkill soils commonly are adjacent to Lenawee, Lenawee Variant, Linwood, and Tiro soils. Lenawee and Lenawee Variant soils do not have organic layers. Linwood soils have an organic surface layer. They are in positions on the landscape similar to those of the Wallkill soils. The somewhat poorly drained, mineral Tiro soils are in the higher positions on uplands.

Typical pedon of Wallkill silt loam, lacustrine substratum, occasionally flooded, about 5 miles southwest of Willard, in Richmond Township; about 1,283 feet west and 82 feet north of the intersection of Township Roads 30 and 14; quadrangle 4, lot 10; T. 1 N., R. 24 W.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium and fine granular structure; friable; neutral; clear smooth boundary.

Bg1—12 to 20 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; common faint very dark grayish brown (10YR 3/2) coatings and very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; clear wavy boundary.

Bg2—20 to 29 inches; dark grayish brown (10YR 4/2) silt loam; common medium faint brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable; common faint very dark grayish brown (10YR 3/2) coatings and very dark gray (10YR 3/1) organic coatings on faces of peds; few distinct strong brown (7.5YR 4/6) stains; neutral; gradual wavy boundary.

2Oa—29 to 49 inches; black (N 2/0) sapric material (muck); weak medium granular structure; friable; about 10 percent fiber, 1 percent rubbed; dark brown (7.5YR 3/4) fiber; strongly acid; gradual wavy boundary.

3Cg—49 to 60 inches; dark gray (N 4/0) silty clay loam stratified with silt loam; few fine prominent olive brown (2.5Y 4/4) mottles; friable; strongly acid.

The upper mineral material ranges from 16 to 40 inches in thickness. The Ap horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is silt loam, loam, or silty clay loam. The 2Oa horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The 3Cg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 3.

Formation of the Soils

This section relates the major factors of soil formation to the soils in Huron County and explains some of the processes of soil formation.

Factors of Soil Formation

The major factors of soil formation are parent material, climate, relief, living organisms, and time *(12)*. Climate and living organisms, particularly vegetation, are the active forces of soil formation. Their effect on the parent material is modified by relief and by the length of time that forces of soil formation have acted upon the parent material. The relative importance of each factor differs from place to place. In some areas one factor dominates and determines most of the soil properties. In most areas, however, the interaction of all five factors determines the distinctive features that form and thus characterize the soil in a given place.

Parent Material

The soils in Huron County formed in several kinds of parent material, most of which is mineral but some of which is organic. The parent material includes glacial till, beach ridge deposits laid down by glacial lakes, glacial outwash, lacustrine sediment, residuum of sedimentary bedrock, recent alluvium, and organic deposits. The characteristics of the parent material greatly affect the texture of the soil.

The county was covered by glaciers during the Pleistocene. Thus, glacial till is the major parent material of the soils in the county. Bennington, Blount, Cardington, Condit, and Glynwood are examples of soils that formed in glacial till. The till is fairly homogeneous and is uniform in texture. The soils that formed in this material have a moderately fine textured subsoil.

Beach ridges were formed along the edges of the glacial lakes in the county. Elnora, Oshtemo, and Spinks are examples of soils that formed in these deposits. These soils generally have a moderately coarse textured or coarse textured subsoil.

Outwash of sand and gravel was deposited by meltwater along the glacial streams in the county. Much of this coarse textured material was later covered by loamy outwash. Chili and Jimtown soils formed in glacial outwash.

Lacustrine material consisting of loamy to clayey sediment was deposited in postglacial lake basins in the southern part of the county. Some soils formed in silty and loamy lacustrine material. Examples are the moderately coarse textured and medium textured Kibbie and Tuscola soils. Some soils formed in silty and clayey lacustrine deposits. Examples are Lenawee, Saylesville, and Shinrock soils, which have a moderately fine textured and fine textured subsoil.

Organic matter accumulated in shallow lakes as trees, grasses, and sedges died and settled to the bottom. Carlisle, Linwood, and Pinnebog soils formed in the partially decomposed remains of these plants. These soils are in areas in depressions and drainageways where the water table is high enough to protect the soils from rapid and total decomposition.

Some of the soils in the county formed in material weathered from limestone or dolomite bedrock. The bedrock underlying these soils is highly fractured. The dominant soils that formed in material weathered from bedrock are those of the Castalia series. These soils are in areas where the bedrock extended above the glacial lake.

Recent alluvial or floodwater deposits are among the youngest parent materials in the county. These materials are still accumulating because fresh sediment is periodically deposited during the overflow of streams. The sediment is dominantly from the surface layer of the mineral soils on the higher uplands and is characteristically fertile. Holly, Lobdell, Orrville, and Tioga soils formed in alluvium.

Climate

The climate in Huron County is too uniform to have significantly contributed to differences among the soils within the county. The climate has favored physical changes and chemical weathering in the parent material and biological activity. The climate is largely responsible for the kind of vegetation in the county, which originally was dominantly hardwoods.

The amount of rainfall has been adequate for percolating water to leach carbonates to a moderate depth in Bennington, Cardington, Shinrock, and other soils in the county. The frequency of rainfall has caused wetting and drying cycles that favor the translocation of clay minerals and the formation of soil structure in Chili, Cardington, and other soils.

The range of temperature variations has favored both physical change and chemical weathering in the parent material. Freezing and thawing have contributed to the formation of soil structure. Warm temperatures in summer have promoted chemical reactions in the weathering of primary minerals. Rainfall and temperature have been conducive to plant growth to the extent that organic matter has accumulated in the topsoil of all the soils in the county. Differences in relief have contributed to some variations in the microclimate of some areas.

More information about the climate in the county is given in the section "General Nature of the County."

Relief

Relief tends to modify the effects of climate. Relief can account for the formation of different soils from the same kind of parent material. Soils on hillsides generally are drier than soils in the adjacent depressions because water runs off the hillsides and collects in the depressions. Whether or not a soil has a seasonal high water table is largely determined by relief. Alexandria, Bennington, and Condit soils all formed in glacial till. The well drained Alexandria soils generally formed in areas where the slope is steep enough to allow rapid runoff. The somewhat poorly drained Bennington soils formed in areas where runoff is slow or medium. The poorly drained Condit soils formed in nearby depressional areas where some plant residue accumulated because of a water table near or above the surface during extended wet periods.

Most areas in the county are nearly level to sloping. Most of the more poorly drained soils are on flats and in depressions. The steepest soils are in areas that are dissected by major streams and drainageways.

Living Organisms

At the time Huron County was settled, the vegetation was predominantly hardwoods, mainly beach, maple, oak, hickory, and ash. Swamps and other low areas supported swamp forest vegetation, mainly swamp white oak, pin oak, elm, and cottonwood. Grassy clearings occurred as marshy openings in the poorly drained swales.

Soils that formed in forested areas are subject to acid leaching. As a result, the subsoil is lower in content of exchangeable bases than the substratum. These soils generally are acid and are moderate or low in natural fertility. Examples are Cardington, Bennington, and Blount soils. The soils in swales and low areas have a greater accumulation of organic matter because the water table is high for longer periods. Colwood, Lenawee, and Pewamo are examples of these dark, fertile soils.

Small animals, insects, worms, fungi, and bacteria mix the soils and add organic matter. Their burrowing and mixing result in more permeable soils.

Human activities also affect soil formation. Some areas in the county have been drained or irrigated. In other areas soil material has been removed and relocated for construction purposes. Applications of lime, fertilizer, and other chemicals and amendments have changed the chemistry of the soils and have affected other soil properties, such as structure.

Time

Time is needed for the other soil-forming factors to produce their effects. The age of a soil is indicated to some extent by the degree of profile development. In many areas factors other than time have been responsible for most of the differences in the kind and distribution of horizons in the various soils. The length of time that the parent material has been in place and has been affected by vegetation and climate is an important factor in soil formation. The influence of time on soil formation is modified by relief and by the nature of the parent material. If the parent material weathers slowly, the profile forms slowly. In steep areas erosion can remove the soil material almost as quickly as a soil forms. As a result, the soils in these areas have no distinct horizons.

In terms of geologic age, the soils in Huron County have been forming for a relatively short period. This amount of time accounts for the relatively shallow depth of leaching and the slightly acid or neutral reaction in many of the soils.

Soils that formed in recent alluvium, such as Lobdell, Orrville, and Tioga soils, have horizons that are not clearly expressed. Periodic deposits of fresh sediment retard the soil-forming processes in these soils.

Processes of Soil Formation

The processes of soil formation have distinctly altered most of the parent materials in the county, as is evidenced by the distinct profile development characteristic of the soils that formed in glacial till on till plains and in glacial outwash on kames and terraces. In contrast, the parent material on flood plains has been only slightly modified.

All of the factors of soil formation interact in the processes of soil formation. The four main processes responsible for soil formation are additions, removals, transfers, and transformations *(15)*. Some of these processes promote horizon differentiation, but others tend to retard differentiation or obliterate existing differences.

The most significant addition to the soils in Huron County is the accumulation of organic matter. Soils that formed in areas where a high water table retarded decomposition of the organic matter have a thick, dark surface layer. This layer is high in content of organic matter, has good structure, and has high base saturation. Colwood, Lenawee, and Pewamo are examples of these soils. Some organic matter has accumulated in most of the soils in the county. Where the layer of accumulation was originally thin, however, plowing and cultivating have incorporated it into other layers or have destroyed it by accelerating decomposition through increased aeration. In some areas erosion has removed a thin layer of topsoil that had an accumulation of organic matter. Alexandria, Cardington, Otisville, and Spinks are examples of soils that have a limited content of organic matter.

Another example of the process of addition is evident in soils on flood plains, such as Lobdell and Orrville soils. These soils periodically receive additions of soil material deposited by floodwater.

Leaching of carbonates from calcareous parent material is one of the most significant losses. It precedes many other chemical changes in the solum. In most of the glacial till in Huron County, the content of carbonates ranges from 15 to 25 percent. Most of the light colored soils that formed in glacial till have been leached to a depth of 20 to 36 inches. The upper 24 inches is now acid. Carbonates in coarse textured soils, such as Spinks and Elnora soils, generally have been leached to a depth of more than 36 inches. Other minerals in the soils are subject to the chemical weathering that follows leaching. The most susceptible minerals are acted upon first. The rate of weathering tends to decrease over time because the most stable minerals that remain weather more slowly.

Following the removal of carbonates, alteration of such minerals as biotite and feldspar results in changes in color within the soil profile. Free iron oxides form and may be segregated by the influence of a fluctuating high water table. This process results in grayish and brownish colors and mottles, which are evident in Pewamo soils. If the soil does not have a seasonal water table, brownish colors that have higher chroma and redder hue than those in the C horizon are typical.

The main kind of transfer is the movement of clay from the A horizon to the B horizon during periods of seasonal wetting and drying. The fine clay becomes suspended in percolating water moving through the A horizon. It is carried downward by the water to the B horizon, where it is deposited on the faces of peds. The transfer of fine clay accounts for the patchy or nearly continuous clay films on the faces of peds in the B horizon of Bennington, Cardington, and other soils. Various sesquioxides also have been transferred from the surface layer to lower layers through this weathering process.

The transformation of mineral compounds occurs in most soils. Gleying, or the reduction and solution of ferrous iron, has occurred in the very poorly drained to somewhat poorly drained soils. This reduction is evident in Pewamo, Condit, and Prout soils. It is caused by a recurring high water table. A gray soil color indicates conditions that generally favor the reduction process. Reduced iron is soluble, but it commonly has been moved only a short distance within the soils in the county. Some of the iron is reoxidized and segregated, forming distinct yellow and red mottles. The mottles in the more poorly drained soils in the county formed through this alteration of iron. Accumulations of iron and manganese oxide are common in the somewhat poorly drained to very poorly drained soils. They occur as dark brown or black stains on the faces of peds or as small concretions.

Another example of a transformation is the alteration of primary silicate minerals. As these minerals are chemically weathered, secondary minerals, mainly those of the layer-lattice silicate clays, form. Most of the layer-lattice clays remain in place in the soil profile, although some clay from the topsoil commonly is transferred to the subsoil.

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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.

Aspect. The direction in which a slope faces.

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:

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.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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 (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures 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.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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 to 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 human or animal activities 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.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

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, or 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 the 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.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

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 the 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, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A surface horizon of mineral soil material that is dark colored and relatively thick, contains at least 0.58 percent organic carbon, is not massive or hard or very hard when dry, and has a base saturation of more than 50 percent.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, 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.

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.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

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.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

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 degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	below 3.5
Extremely acid	3.5 to 4.4
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.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

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.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

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 substratum. 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.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

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, in millimeters, of separates recognized in the United States are as follows:

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 substratum. 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 if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsidence. The loss in volume that occurs in mucky soils when they oxidize or dry.

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.

Substratum. The part of the soil below the solum.

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.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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 that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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, 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.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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 a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.