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 Hardin County, Ohio

How To Use This Soil Survey

General Soil Map

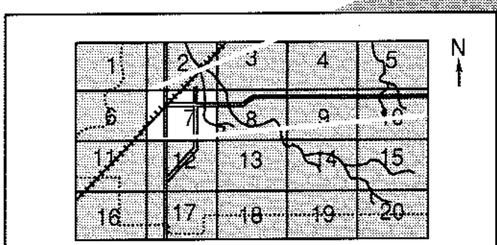
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

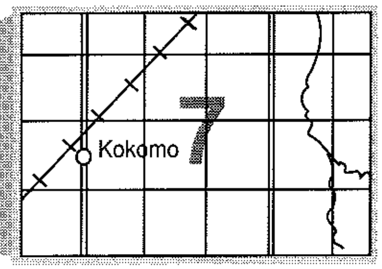
Detailed Soil Maps

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.

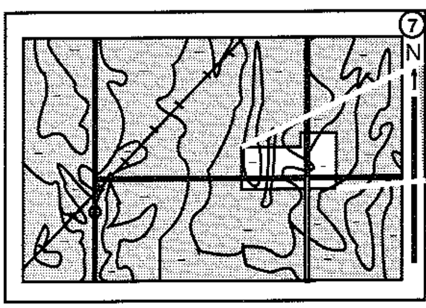


INDEX TO MAP SHEETS



MAP 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.



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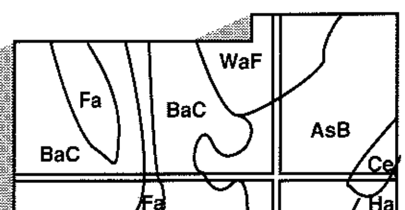

AREA OF INTEREST

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.

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 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. 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 survey is part of the technical assistance furnished to the Hardin Soil and Water Conservation District. The preparation of this survey was materially aided by funds provided by the Hardin County Commissioners.

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

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: A typical farm in Hardin County. The house and farm buildings are on Glynwood soils.

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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 Hardin County, Ohio. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to 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 moderately deep 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 near the surface makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Lawrence E. Clark
State Conservationist
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Soil Survey of Hardin County, Ohio

By K.E. Miller and R.A. Robbins, Ohio Department of Natural Resources, Division of Soil and Water Conservation

Fieldwork by R.A. Robbins, K.E. Miller, and D.K. Musgrave, 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

HARDIN COUNTY is in the west-central part of Ohio (fig. 1). It is on the watershed divide between the Great Lakes drainage basin and the Ohio River. It has an area of 301,472 acres, or 471 square miles. Kenton, the county seat, is near the center of the county. In 1980, the population of the county was about 33,000 and the population of the city of Kenton was about 8,600 *(6)*.

Most of the county is used for farming. The main enterprises are cash-grain farming, livestock production, and dairying. Built-up urban land makes up only about 4 percent of the county and is expanding at a slow rate *(11)*. In most areas that are used as farmland, a drainage system has been installed to improve crop production. Most of the soils in the county are well suited to field crops, pasture, and trees.

Most of the soils in Hardin County are nearly level and gently sloping and are dissected in some areas by small rivers and streams. Wetness is a major limitation in most of the soils. The hazard of erosion generally is severe on the sloping to moderately steep soils on end moraines and along stream valleys. Two locally unique physiographic features in the county are the Scioto Marsh and the Hog Creek Marsh. Both are in the western half of the county and total approximately 26,000 acres.

Figure 1.—Location of Hardin County in Ohio.

General Nature of the County

This section gives general information about the county. It describes history; physiography, relief, and drainage; farming; natural resources; and climate.

History

Before the arrival of white settlers, the survey area was occupied by the Wyandot and Shawnee Indians. The Indians grew corn and other crops in small clearings to supplement their diet *(9)*.

During the period between the French and Indian War in 1756 and the War of 1812, the survey area was the scene of hostilities among the Indians, the American colonists, the French, and the English. The defeat of the Indians and others in the War of 1812 and the acquisition of their lands opened the way for settlement of the area *(9)*.

The early settlers came from other settlements in Ohio, Virginia, and the Northeastern States. Most were of German, English, Irish, and Scottish descent. These settlers cleared the forests in order to raise livestock and cultivate crops. Initially, they cultivated the better drained, rolling soils along streams and the higher areas on end moraines. Cattle, hogs, and sheep were pastured in the remaining area of woodland and on the wetter soils. Corn, wheat, and hay were grown for local consumption. Large areas of the fertile lowlands and marshes in the county were not opened to cultivation until the latter part of the 1800's, with the advent of tiling and ditching *(9)*.

Agriculture has played the dominant role in the settlement and development of the county. The economy of the county has remained oriented toward agriculture since the early 1800's. Industrialization did not reach the county until the 1940's, and then its impact was minor. It was not until 1980 that the population of the county surpassed that of 1900 *(6)*.

Physiography, Relief, and Drainage

Most of the physiographic features in the county are a result of the Wisconsinan Glaciation. Glacial deposits cover the entire county *(7)*. They are about 2 to nearly 100 feet deep over bedrock. Irregularly shaped ridges generally run in a westerly direction across the county. They are called end moraines. They formed at the melting edge of the nearly stationary glacier. The more nearly level areas in the uplands between the end moraines are ground moraines. The characteristics of the ground moraines reflect a nearly steady rate of retreat by the glacier. Level or nearly level lake plains and marshes are near the headwaters of rivers and streams and between the end moraines. They formerly were shallow glacial lakes.

The surface features in Hardin County range from gently rolling hills and a few steep valley walls to extensive nearly level plains and flat basins. Total relief is about 267 feet. The highest point in the county is a ridge in an area near the Hardin-Logan County line where Treece Road enters Logan County. The lowest point is in an area where the Blanchard River enters Hancock County.

The Wabash Moraine, which bisects Hardin County generally from east to west, is the main physiographic feature that divides the surface drainage in the county. It is the summit, or divide, from which surface water flows in opposite directions. Of the six large drainage basins in the county, those of the Miami River and the Upper Scioto River drain southward to the Ohio River. The basins of the Ottawa River, the Upper and Lower Blanchard Rivers, and Tymochtee Creek drain northward to Lake Erie. The largest basin is that of the Upper Scioto River. It drains more than 180 square miles in the county *(19)*.

Farming

In 1985, Hardin County had 1,210 farms, which made up about 90 percent of the land in the county. The average size of the farms was about 224 acres *(5)*. In 1982, most of the farms were about 50 to 500 acres in size, although some were smaller than 10 acres and a few were more than 2,000 acres *(17)*.

In 1985, soybeans were grown on 102,700 acres in the county, corn on 81,500 acres, wheat on 30,700 acres, oats on 6,100 acres, and hay on 7,900 acres *(5)*. About 26,100 acres was used for small grain crops other than wheat and oats, for pasture, or for specialty crops. In 1984, about 22,000 acres was used as woodland, including the woodland used as pasture *(11)*. The acreage of woodland and pasture has decreased in recent years because of the conversion to cultivated land.

Natural Resources

Dolomite, limestone, sand, gravel, and clay have been quarried throughout Hardin County at one time or another. The availability of most of these resources is limited, however, mainly because the deposits are relatively thin.

Dolomite and limestone are the major components of the bedrock in the county. These rocks are in the Niagara and Monroe Groups, which formed during the Silurian and Early Devonian ages *(4)*. Limestone has been mined from these formations in several parts of the county. Only two quarries, however, are still in operation. They are in the north-central part of the county. They are quarried for fluxing dolomite and crushed limestone. Quarries near Dunkirk and Kenton have been abandoned and are now used as recreational areas. Most of the limestone in the county is suitable for many agricultural and industrial uses.

Small sand and gravel pits are in scattered areas throughout the county, mostly along rivers and streams. These pits are limited in size, ranging from 1 to 10 acres. One pit along Taylor Creek reached a size of about 100 acres before it was abandoned.

Climate

Hardin 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 in 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 Kenton, 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 28 degrees F and the average daily minimum temperature is 19 degrees. The lowest temperature on record, which occurred at Kenton on January 24, 1963, is -20 degrees. In summer, the average temperature is 71 degrees and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July 14, 1954, 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 21 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 17 inches. The heaviest 1-day rainfall during the period of record was 3.51 inches at Kenton on June 28, 1957. Thunderstorms occur on about 42 days each year. Tornadoes and severe thunderstorms occur occasionally. These storms are usually local in extent and of short duration. They cause damage in scattered areas.

The average seasonal snowfall is about 29 inches. The greatest snow depth at any one time during the period of record was 17 inches. On the average, 8 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 about 60 percent of the time possible in summer and 35 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 11 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 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 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 this survey are described in the "National Soils Handbook" of the Soil Conservation Service. The soil maps made for conservation planning on individual farms prior to the start of the survey and a general soil map of the county were among the references used.

Before fieldwork began, preliminary boundaries of slopes and landforms were plotted on aerial photographs, which were taken in 1949 and 1969 at a scale of 1:15,840. United States Geological Survey topographic maps, at a scale of 1:24,000, helped the soil scientists to relate land and image features.

A reconnaissance was made by car before the soil scientists traversed the surface on foot, examining the soils. In areas of the Blount-Glynwood-Pewamo association and in other areas where the soil pattern is very complex, traverses were spaced as close as 200 yards. In areas of the Milford-Patton association and in other areas where the soil pattern is relatively simple, traverses were spaced about 0.5 mile apart.

As they traversed the surface, the soil scientists divided the landscape into segments based on the use and management of the soils. For example, a hillside would be separated from a swale and a gently sloping ridgetop from a moderately steep side slope. In most areas soil examinations along the traverses were made at points 50 to 300 yards apart, depending on the landscape and the soil pattern.

Observations of such features as landforms, blown-down trees, vegetation, roadbanks, and animal burrows were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined to a depth of about 5 feet or to bedrock within a depth of 5 feet. The pedons described as typical were observed and studied in pits that were dug with shovels and spades.

At the beginning of the survey, sample areas were selected to represent the major landscapes in the county. These areas were then mapped. Extensive notes were taken on the composition of the map units in these preliminary study areas. These notes were modified as mapping progressed and a final assessment of the composition of the individual map units was made. Some transects were made to determine the composition of the Morley-Milton and Morley-Belmore complexes.

Samples for chemical and physical analyses were taken from representative sites of several of the soils in the survey area. The analyses were made by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The results of the analyses are stored in a computerized data file at the laboratory. A description of the laboratory procedures can be obtained on request from the laboratory. The results of the studies can be obtained from the Department of Agronomy, Ohio State University; the Ohio Department of Natural Resources, Division of Soil and Water Conservation; and the Soil Conservation Service, State Office, Columbus, Ohio.

After completion of the soil mapping on aerial photographs, map unit delineations were transferred by hand to the corresponding mylar set of the same photographs. Surface features were recorded from observation of the maps and the landscape.

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 in this survey 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 system.

1. Blount-Pewamo Association

Nearly level and gently sloping, somewhat poorly drained and very poorly drained soils that formed in glacial till on till plains

This association is on broad flats and slight rises on ground moraines. In most areas the flats are interspersed with drainageways and shallow depressions. Many areas of the better drained soils occur as areas of the more sloping soils on low knolls and along the side slopes of major drainageways. Slope is 0 to 6 percent.

This association makes up about 60 percent of the county. It is about 55 percent Blount soils, 30 percent Pewamo soils, and 15 percent soils of minor extent.

Blount soils are nearly level and gently sloping and are somewhat poorly drained. They are on broad flats, slight rises, low knolls, and side slopes along drainageways. Permeability is slow or moderately slow. Surface runoff is slow or medium. The seasonal high water table is perched in the upper part of the subsoil during extended wet periods. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is moderate.

Pewamo soils are nearly level and very poorly drained. They are in depressions and drainageways and on broad flats. Permeability is moderately slow. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during extended wet periods. The surface layer is silty clay loam and has a high content of organic matter. The available water capacity is high.

Some of the minor soils in this association are the moderately well drained Glynwood soils on the higher knolls and in the more sloping areas along drainageways, Haskins soils on slight rises and low knolls, and Eel and Sloan soils, which formed in alluvium on flood plains. Haskins soils are more loamy than the major soils.

The major soils are used mainly as cropland. They are especially well suited or well suited to corn, soybeans, small grain, grass-legume hay, and pasture. Seasonal wetness and erosion are the main management concerns on the Blount soils. Ponding and surface compaction are the main management concerns on the Pewamo soils.

The major soils are moderately well suited or poorly suited to buildings and are poorly suited to septic tank absorption fields. Seasonal wetness in the Blount soils and ponding on the Pewamo soils are the main limitations. The moderately slow or slow permeability is an additional limitation on sites for septic tank absorption fields. Because the Blount soils are better drained, they are better sites for buildings and septic tank absorption fields than the Pewamo soils.

2. Blount-Glynwood-Pewamo Association

Nearly level to sloping, somewhat poorly drained, moderately well drained, and very poorly drained soils that formed in glacial till on till plains

This association is in hummocky areas on end moraines and in areas dissected by perennial streams

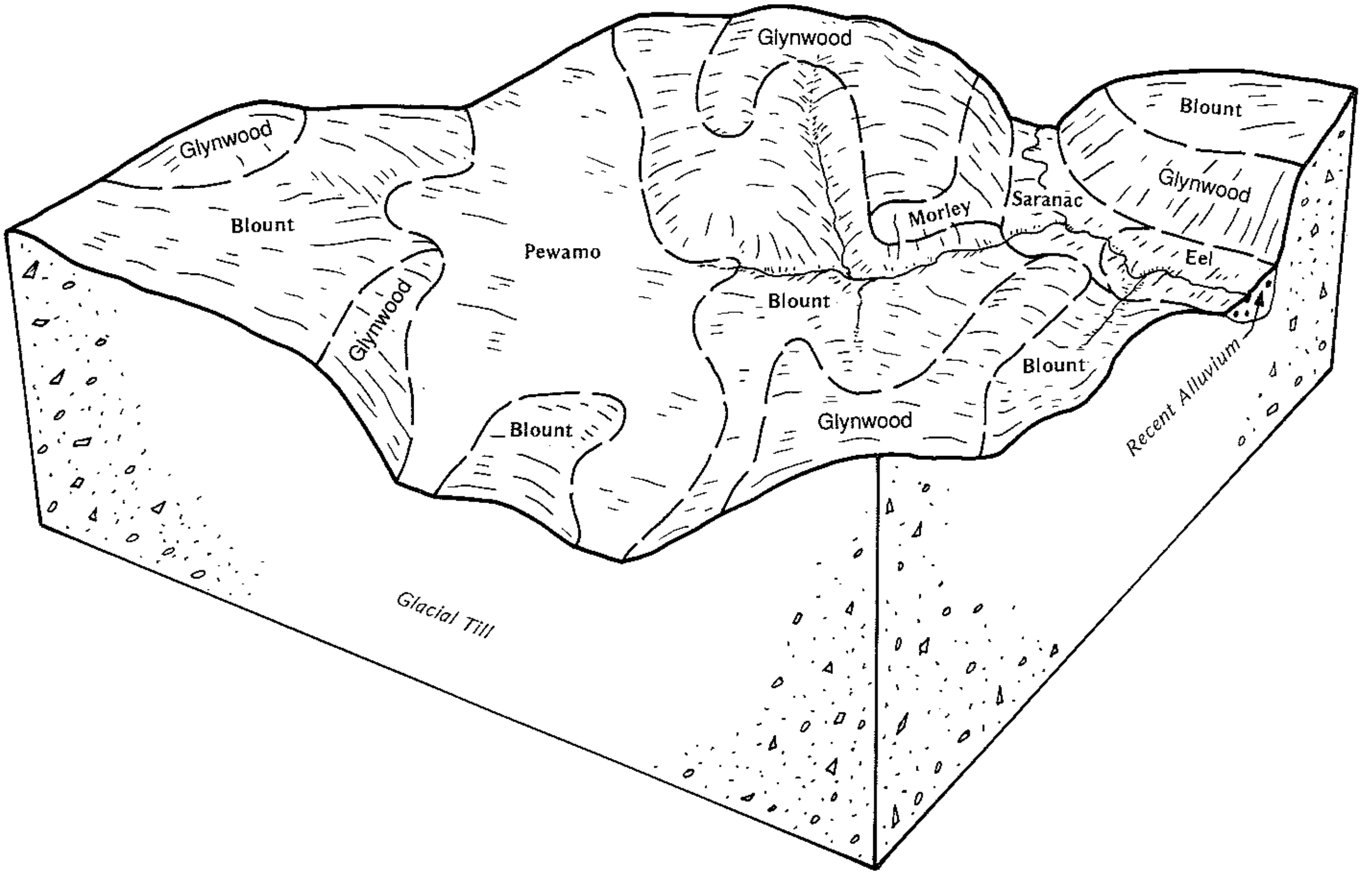

Figure 2.—Typical pattern of soils and parent material in the Blount-Glynwood-Pewamo association.

on ground moraines. The landscape is characterized by knolls, ridges, shallow depressions, and drainageways. Slope is 0 to 12 percent.

This association makes up about 26 percent of the county. It is about 45 percent Blount soils, 30 percent Glynwood soils, 15 percent Pewamo soils, and 10 percent soils of minor extent (fig. 2).

Blount soils are nearly level and gently sloping and are somewhat poorly drained. They are on low knolls and on side slopes along drainageways. Permeability is slow or moderately slow. Surface runoff is slow or medium. The seasonal high water table is perched in the upper part of the subsoil during extended wet periods. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is moderate.

Glynwood soils are gently sloping and sloping and are moderately well drained. They are on knolls, ridges, and side slopes. Permeability is slow. Surface runoff is medium or rapid. The seasonal high water table is perched in the lower part of the subsoil during extended wet periods. The surface layer is silt loam or clay loam and has a moderate or moderately low content of organic matter. The available water capacity is moderate.

Pewamo soils are nearly level and very poorly drained. They are in shallow depressions and drainageways. Permeability is moderately slow. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during extended wet periods. The surface layer is silty clay loam and has a high content of organic matter. The available water capacity is high.

Some of the minor soils in this association are the well drained Morley soils on knolls and the side slopes of stream valleys and Eel and Saranac soils, which formed in alluvium on flood plains.

The major soils are used mainly as cropland. The nearly level areas of these soils are especially well suited or well suited to corn, soybeans, small grain, grass-legume hay, and pasture. The gently sloping and sloping areas are well suited, moderately well suited, or poorly suited to those crops. Erosion and the slope are the main management concerns on the Blount and Glynwood soils. Seasonal wetness is a management concern in the Blount and Pewamo soils. Ponding is an additional management concern on the Pewamo soils.

The major soils are well suited, moderately well suited, or poorly suited to buildings and are moderately well suited or poorly suited to septic tank absorption fields. Seasonal wetness, ponding, and the slow or moderately slow permeability are the main limitations. Because the Glynwood soils are better drained, they are better sites for buildings and septic tank absorption fields than the Blount and Pewamo soils.

3. Milford-Patton Association

Nearly level, very poorly drained soils that formed in lacustrine sediment on lake plains

This association is on broad flats on lake plains. The landscape is characterized by broad, uniform flats and shallow depressions crossed by many drainage ditches. Slope is 0 to 2 percent.

This association makes up about 5 percent of the county. It is about 50 percent Milford soils, 15 percent Patton soils, and 35 percent soils of minor extent.

Both of the major soils are on broad, uniform flats and in long, narrow drainageways. They formed in moderately fine textured and medium textured lacustrine sediment. Permeability is moderately slow. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface. The soils are subject to ponding during extended wet periods. The surface layer is silty clay loam and has a high content of organic matter. The available water capacity is high.

Some of the minor soils in this association are Colwood, Pewamo, and Roundhead soils. Colwood soils are stratified and are more loamy than the major soils. They are on very slight rises or in landscape positions similar to those of the major soils. Pewamo soils formed in glacial till. They are along the edges of lake plains. Roundhead soils have a surface layer of muck. They are in depressions.

The major soils are used mainly as cropland. They are especially well suited to corn, soybeans, small grain, grass-legume hay, and pasture. Seasonal wetness and surface compaction are the main management concerns.

The major soils are poorly suited to building site development and septic tank absorption fields. Ponding and the moderately slow permeability are the main limitations.

4. Roundhead-McGuffey Association

Level, very poorly drained soils that formed in organic material and in the underlying lacustrine sediment on lake plains

This association is characterized by broad, uniform flats that are crossed by drainage ditches. The major soils are subject to ponding. Slope is less than 1 percent.

This association makes up about 4 percent of the county. It is about 45 percent Roundhead soils, 25 percent McGuffey soils, and 30 percent soils of minor extent.

Both of the major soils are on broad, uniform flats on lake plains. Both formed in a thin layer of organic material and in the underlying lacustrine sediment. The lacustrine sediment is medium textured and moderately fine textured in the Roundhead soils and fine textured in the McGuffey soils. Permeability is moderately slow or slow in the Roundhead soils and very slow in the McGuffey soils. Surface runoff is very slow or ponded on both soils. The seasonal high water table is near or above the surface during extended wet periods. The surface layer is muck and has a very high content of organic matter. The available water capacity is very high in the Roundhead soils and moderate or high in the McGuffey soils.

Some of the minor soils in this association are Linwood soils, which have 16 to 38 inches of organic material, and Pewamo Variant soils, which are underlain by glacial till. Both of these soils are in landscape positions similar to those of the major soils.

The major soils are used mainly as cropland. They are well suited or moderately well suited to corn, soybeans, and a few specialty crops. Seasonal wetness and soil blowing are the main concerns in managing these soils for crops. Because of the low positions on the landscape, crops are more susceptible to frost on these soils than on the nearby mineral soils.

The major soils are generally unsuited to buildings and septic tank absorption fields. Ponding and the moderately slow or very slow permeability are the main limitations. A high shrink-swell potential in the McGuffey soils is an additional limitation on building sites.

5. Latty-Fulton-Del Rey Association

Nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in lacustrine sediment on lake plains

This association generally is on broad flats and slight rises on lake plains. In some areas, however, it is on

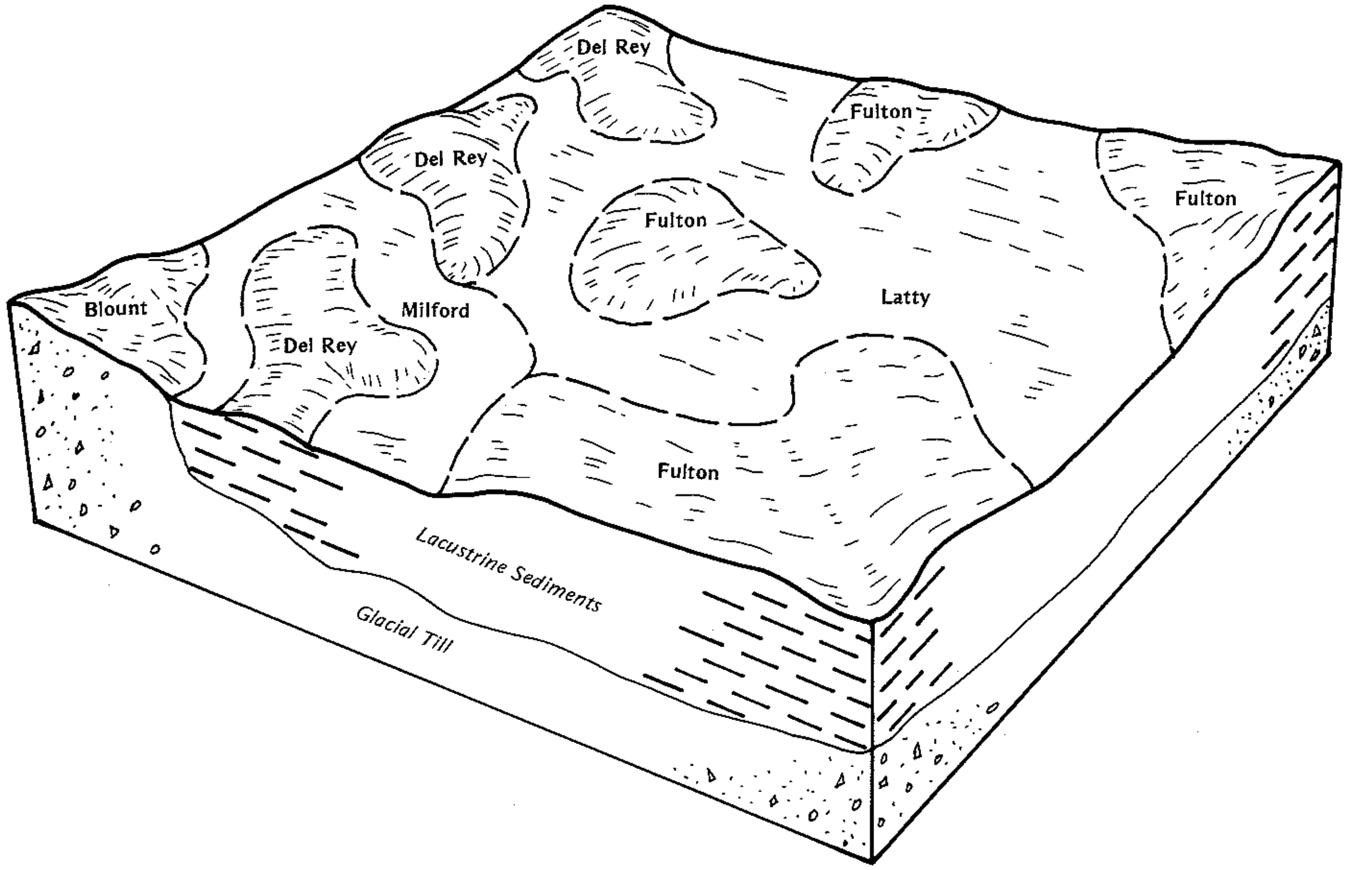

Figure 3.—Typical pattern of soils and parent material in the Latty-Fulton-Del Rey association.

low knolls and side slopes along drainageways. Slope is 0 to 6 percent.

This association makes up about 3 percent of the county. It is about 30 percent Latty soils, 25 percent Fulton soils, 10 percent Del Rey soils, and 35 percent soils of minor extent (fig. 3).

Latty soils are nearly level and very poorly drained. They are on broad flats, in depressions, and along drainageways. Permeability is very slow. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during extended wet periods. The shrink-swell potential is high. The surface layer is silty clay loam or silty clay and has a moderate content of organic matter. The available water capacity is moderate.

Fulton soils are nearly level and gently sloping and are somewhat poorly drained. They are on slight rises, on low knolls, and on slopes along streams and drainageways. Permeability is slow or very slow. Surface runoff is slow or medium. The seasonal high water table is perched in the upper part of the subsoil during extended wet periods. The shrink-swell potential is high. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is moderate.

Del Rey soils are nearly level and somewhat poorly drained. They are on slight rises and low knolls. Permeability is slow. Surface runoff also is slow. The seasonal high water table is in the upper part of the subsoil during extended wet periods. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is moderate.

Some of the minor soils in this association are Blount, Milford, Saranac, and Shinrock soils. Blount soils formed in glacial till near slope breaks to the uplands. They are on slight rises, low knolls, and side slopes along drainageways. Milford soils are in depressions and drainageways. They are darker than the major soils. Saranac soils formed in alluvium on flood plains. The moderately well drained Shinrock soils are on the higher knolls.

The major soils are used mainly as cropland. They are well suited or moderately well suited to corn, soybeans, small grain, grass-legume hay, and pasture.

Seasonal wetness is the main concern in managing these soils for crops. A high content of clay in the Fulton and Latty soils and a hazard of erosion on the Fulton soils are additional management concerns.

The major soils are moderately well suited, poorly suited, or generally unsuited to buildings and are poorly suited or generally unsuited to septic tank absorption fields. Seasonal wetness, ponding, and the slow or very slow permeability are the main limitations. The high shrink-swell potential is an additional limitation affecting building site development on the Fulton and Latty soils.

6. Fox-Westland-Sleeth Association

Nearly level to sloping, well drained, very poorly drained, and somewhat poorly drained soils that formed in glacial outwash on outwash plains, stream terraces, kames, and end moraines

This association is on outwash plains and stream terraces. The landscape is characterized by broad, low flats interspersed with low knolls, ridges, and shallow depressions. Slope is 0 to 12 percent.

This association makes up about 1 percent of the county. It is about 30 percent Fox soils, 25 percent Westland soils, 10 percent Sleeth soils, and 35 percent soils of minor extent (fig. 4).

Fox soils are nearly level to sloping and are well drained. They are on slight rises, side slopes, low knolls, and ridges. Permeability is moderate in the subsoil and rapid or very rapid in the underlying glacial outwash. Runoff is slow to rapid. The surface layer is silt loam or clay loam and has a moderately low or low content of organic matter. The available water capacity is moderate or low.

Westland soils are nearly level and very poorly drained. They are on flats, in depressions, and along drainageways. Permeability is moderate in the surface layer and subsoil and very rapid in the underlying glacial outwash. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface during extended wet periods. The surface layer is clay loam and has a high content of organic matter. The available water capacity is high.

Sleeth soils are nearly level and somewhat poorly

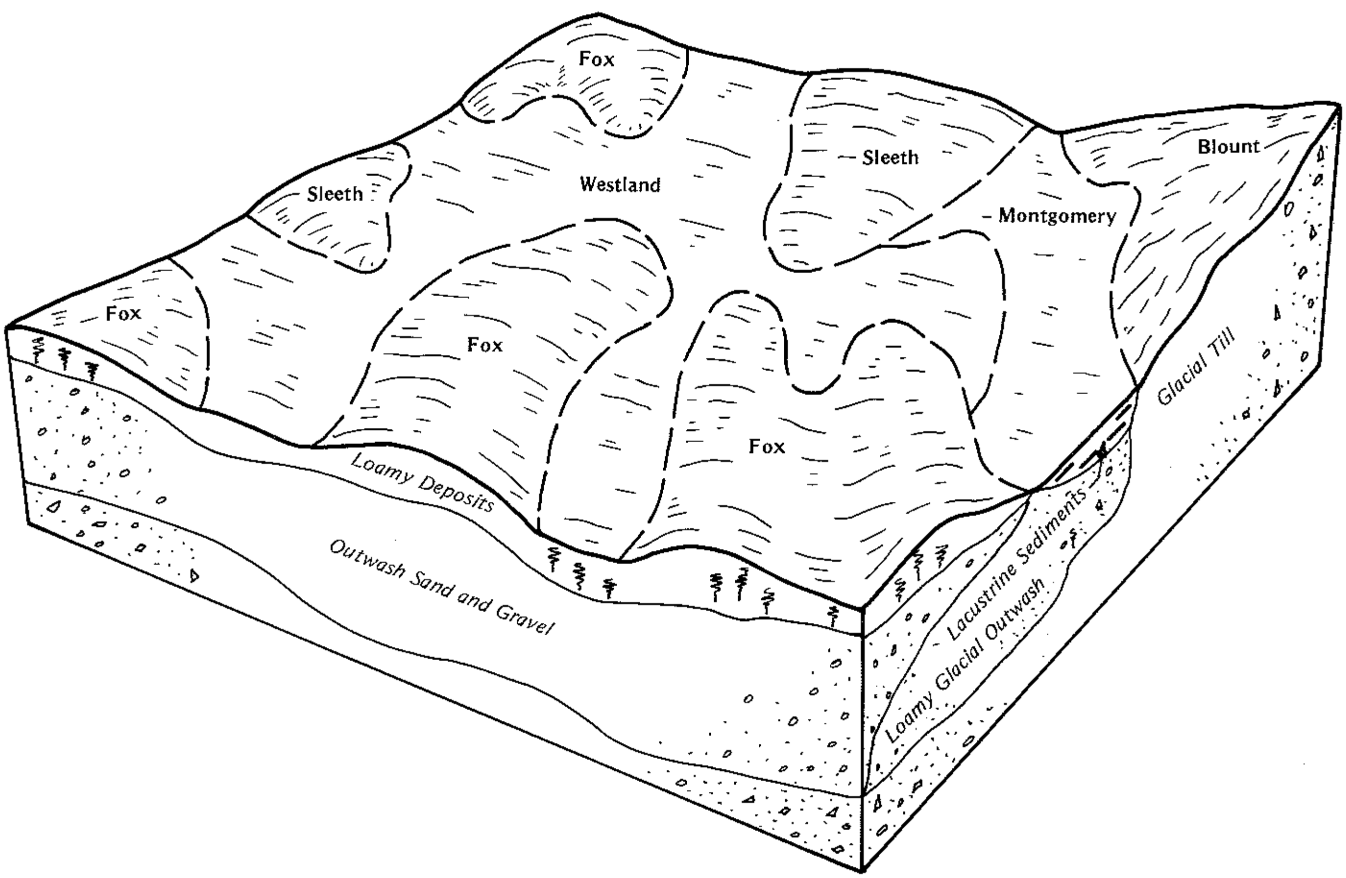

Figure 4.—Typical pattern of soils and parent material in the Fox-Westland-Sleeth association.

drained. They are in slightly elevated areas. Permeability is moderate in the subsoil and very rapid in the underlying glacial outwash. Runoff is slow. The seasonal high water table is in the upper part of the subsoil during extended wet periods. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is high.

Some of the minor soils in this association are the clayey Montgomery soils in depressions; Blount and Glynwood soils, which formed in glacial till on ground moraines and end moraines; and Carlisle soils, which formed in organic material in deep, closed depressions.

The major soils are used mainly as cropland. The nearly level and gently sloping areas of these soils are especially well suited, well suited, or moderately well suited to corn, soybeans, small grain, grass-legume hay, and pasture. The sloping areas are poorly suited to corn, soybeans, and small grain and are moderately well suited to hay and pasture. Erosion and droughtiness in areas of the Fox soils and seasonal wetness in the Sleeth and Westland soils are the main management concerns.

The major soils are well suited, moderately well suited, or poorly suited to buildings and are moderately well suited or poorly suited to septic tank absorption fields. Because the Fox soils are better drained, they are better sites for buildings than the Sleeth and Westland soils. Seasonal wetness is the main limitation in areas of the Sleeth and Westland soils. A moderate shrink-swell potential and the slope are the main limitations if the Fox soils are used as sites for buildings. A poor filtering capacity in the underlying material of the Fox soils can cause contamination of underground water supplies by the effluent from septic tank absorption fields.

7. Nolin-Eel-Fox Association

Nearly level and gently sloping, well drained and moderately well drained soils that formed in alluvium on flood plains and in glacial outwash on stream terraces and outwash plains

This association is in narrow river valleys. The landscape is characterized by flat bottom land and terrace benches. The bottom land is occasionally flooded. Slope typically is 0 to 2 percent, but it is as much as 6 percent in a few areas.

This association makes up about 1 percent of the county. It is about 25 percent Nolin soils, 25 percent Eel soils, 10 percent Fox soils, and 40 percent soils of minor extent.

Nolin soils are nearly level and well drained. They are on narrow, slightly elevated flats and commonly make up the entire width of the flood plains. Permeability is moderate. Surface runoff is slow. The seasonal high water table is in the lower part of the subsoil during extended wet periods. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is high.

Eel soils are nearly level and moderately well drained. They are on narrow flats and commonly make up the entire width of the flood plains. Permeability is moderate. Surface runoff is slow. The seasonal high water table is in the upper part of the profile during extended wet periods. The surface layer is silt loam and has a moderate content of organic matter. The available water capacity is high.

Fox soils are nearly level and gently sloping and are well drained. They are on terrace benches above the flood plains. Permeability is moderate in the subsoil and rapid or very rapid in the underlying material. Surface runoff is slow or medium. The surface layer is silt loam and has a moderately low or low content of organic matter. The available water capacity is moderate.

Some of the minor soils in this association are Blount, Glynwood, Ockley, Sleeth, and Westland soils. Blount and Glynwood soils formed in glacial till on side slopes in the uplands. Ockley soils formed in loamy outwash and in the underlying sandy and gravelly outwash. They are on terrace benches. The somewhat poorly drained Sleeth soils are in slightly elevated areas. The very poorly drained Westland soils are on flats and in depressions and drainageways on terrace benches.

The major soils are used mainly as cropland or woodland. They are well suited to corn, soybeans, grass-legume hay, and pasture. Occasional flooding on the Nolin and Eel soils and droughtiness and erosion in areas of the Fox soils are the main management concerns. Seasonal wetness in the Eel soils is an additional management concern.

The Nolin and Eel soils generally are unsuited to buildings and septic tank absorption fields. The Fox soils are well suited to buildings and moderately well suited to septic tank absorption fields. Occasional flooding and seasonal wetness in areas of the Nolin and Eel soils and a moderate shrink-swell potential and poor filtering capacity in areas of the Fox soils are the main limitations. The poor filtering capacity can result in the pollution of ground water if the Fox soils are used as sites for 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 suitability 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 underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Glynwood silt loam, 2 to 6 percent slopes, is a phase of the Glynwood series.

Some map units are made up 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. Morley-Milton silt loams, 2 to 6 percent slopes, is an example.

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

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

Some of the soil boundaries and soil names in this survey 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

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 range from 5 to 200 acres in size and are irregularly shaped or oval.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 16 inches of brown and yellowish brown, mottled, firm silty clay loam and silty clay. The underlying material to a depth of about 60 inches is brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil is thicker. In a few areas the lower part of the subsoil and the underlying material have less clay. In places the underlying material is silty clay. In a few areas the surface layer is loam. In a few places the soil is poorly drained.

Included with this soil in mapping are small areas of Glynwood, Haskins, Kibbie, and Pewamo soils. The moderately well drained Glynwood soils are on low knolls. Haskins and Kibbie soils are in landscape positions similar to those of the Blount soil. They have less clay in the subsoil than the Blount soil. Also, Kibbie soils have a darker surface layer. The very poorly drained Pewamo soils are in depressions and along drainageways. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Blount soil is perched in the upper part of the subsoil during extended wet periods. Permeability is slow or moderately slow. Surface runoff is slow. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The 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. Deepening outlet ditches can improve the effectiveness of subsurface drainage systems. Conservation tillage systems that leave crop residue on the surface, including no-till planting, reduce the hazard of sheet erosion and increase 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 minimize surface compaction.

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

This soil is moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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 moderately well suited to buildings and poorly suited to septic tank absorption fields. The seasonal wetness and the slow or moderately slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundations. 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. Included areas of the moderately well drained Glynwood soils generally are better sites for buildings than this soil. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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 can reduce the wetness.

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. In most areas it is on side slopes, low knolls, and ridges. In some areas it is at the head of minor drainageways where surface water begins to collect in channels. Most areas range from 5 to 200 acres in size and are irregularly shaped or long and narrow.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 17 inches of yellowish brown, mottled, firm silty clay loam and silty clay. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, very firm silty clay loam glacial till. In some areas the solum is thicker. In a few areas the lower part of the subsoil and the underlying material have less clay.

Included with this soil in mapping are small areas of Glynwood, Haskins, Kibbie, and Pewamo soils. The moderately well drained Glynwood soils are on the crest of knolls and the upper part of side slopes. In some hummocky areas they are eroded and have a surface layer of clay loam. Haskins and Kibbie soils are on the crest of low knolls and on side slopes. They have less clay in the subsoil than the Blount soil. Also, Kibbie soils have a darker surface layer. The very poorly drained Pewamo soils are in depressions and along drainageways. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Blount soil is perched in the upper part of the subsoil during extended wet periods. Permeability is slow or moderately slow. Surface runoff is medium. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The hazard of erosion and the 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. Conservation tillage systems that leave crop residue on the surface, including no-till planting, help to control erosion and increase the rate of water infiltration. Including close-growing crops in the cropping system also helps to control erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels minimize surface compaction.

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

This soil is moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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 moderately well suited to buildings and poorly suited to septic tank absorption fields. The seasonal wetness and the slow or moderately 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 foundations. 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. Included areas of the moderately well drained Glynwood soils generally are better sites for buildings than this soil. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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 can reduce the wetness.

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

BpA—Blount silt loam, limestone substratum, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on till plains. It is commonly on broad flats and slight rises. Most areas range from 10 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 23 inches of dark yellowish brown, mottled, firm silty clay loam and silty clay. The underlying material is yellowish brown, mottled, calcareous, very firm clay loam glacial till. Limestone bedrock is at a depth of about 52 inches. In a few areas the bedrock is within a depth of 40 inches.

Included with this soil in mapping are small areas of Glynwood, Millsdale, Milton, Morley, and Pewamo soils. The moderately well drained Glynwood soils, the moderately deep, well drained Milton soils, and the well drained Morley soils are on low knolls. The moderately deep, very poorly drained Millsdale soils and the very poorly drained Pewamo soils are in depressions and along drainageways. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Blount soil is perched in the upper part of the subsoil during extended wet periods. Permeability is slow or moderately slow. Surface runoff is slow. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The 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. In places bedrock restricts the installation of subsurface drains. Conservation tillage systems that leave crop residue on the surface, including no-till planting, reduce the hazard of sheet erosion and increase 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 minimize surface compaction.

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

This soil is moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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 moderately well suited to buildings and poorly suited to septic tank absorption fields. The seasonal wetness, the slow or moderately slow permeability, and the restricted depth to bedrock are the main limitations. Properly grading building sites helps to keep surface water away from foundations. Because of the depth to bedrock and the seasonal wetness, the soil is better suited to buildings without basements than to buildings with basements. 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. Included areas of the moderately well drained Glynwood soils and the well drained Morley soils generally are better sites for buildings without basements than this soil. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

The limitations affecting septic tank absorption fields can be partially overcome by installing the distribution lines in suitable fill material. 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 can reduce the wetness.

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

Ca—Carlisle muck. This deep, level, very poorly drained soil is in bogs on till plains, outwash plains, and lake plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 1 percent. Most areas range from 5 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable muck about 10 inches thick. Below this to a depth of about 60 inches is black, dark brown, and dark reddish brown, friable muck. In some areas the muck is less decomposed and has more fiber.

Included with this soil in mapping are small areas of Linwood, Milford, and Pewamo soils. These soils are along the periphery of the mapped areas. Linwood soils have silty lacustrine sediment in the underlying material. Milford and Pewamo soils formed in mineral material. Also included, along the Scioto River, are a few areas of soils that are occasionally flooded. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Carlisle soil is near or above the surface during extended wet periods. Permeability is moderately slow to moderately rapid. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is very high. The potential for frost action is high. The soil is characterized by low strength and high compressibility. Tilth is good. The content of organic matter is very high. When dry, the surface layer is subject to soil blowing and fire.

Most areas are used as cropland. Some areas are used for specialty crops. A few areas are undrained and support native plants.

Drained areas of this soil are moderately well suited to corn and soybeans, small grain, and hay and pasture and are well suited to specialty crops, such as carrots and potatoes. The seasonal wetness, soil blowing, and subsidence are the main management concerns. Cultivated crops can be grown year after year if optimum management is applied. A drainage system is needed. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. Outlets for subsurface drains cannot be easily established in some areas. Subsidence or shrinkage, which occurs as a result of oxidation of the organic material after the soil is drained, sometimes causes displacement of subsurface drains. Control of the water table by subirrigation through tile lines reduces the hazards of subsidence, burning, and soil blowing. Planting winter cover crops, delaying tillage until spring, and establishing windbreaks reduce the hazard of soil blowing. The soil can be easily tilled. The surface layer commonly requires compaction rather than loosening when a good seedbed is prepared. The soil readily absorbs water, nutrients, and pesticides because of the very high content of organic matter. Because of the low position on the landscape, plants are more susceptible to frost on this soil than on the higher nearby mineral soils.

This soil is moderately well suited to trees. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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. The trees can be logged during the drier parts of the year or when the soil is frozen.

A few undrained areas of this soil are well suited to habitat for wetland wildlife. In these areas the soil supports water-tolerant trees, cattails, reeds, and sedges.

In the larger areas of this soil, windbreaks are needed to control soil blowing. Selecting the species of trees and shrubs that are tolerant of wetness can reduce the seedling mortality rate. Fast-growing species that have desirable growth characteristics provide adequate protection. Plant competition can be controlled by removing the less desirable trees and shrubs. The trees and shrubs should be planted at right angles to the prevailing wind.

This soil generally is unsuited to buildings and septic tank absorption fields. The ponding, the moderately slow permeability, subsidence, and low soil strength are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, frost action, and subsidence.

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

Co—Colwood loam. This deep, nearly level, very poorly drained soil is on broad flats and very slight rises on lake plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 10 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is black, friable loam about 13 inches thick. The subsoil is about 27 inches of very dark gray, gray, and olive gray, mottled, very friable to firm loam, silty clay loam, silt loam, and fine sandy loam. The underlying material to a depth of about 60 inches is grayish brown, mottled, calcareous, friable silt loam that has thin strata of silty clay loam and loam. In some areas the surface layer is sandy loam.

Included with this soil in mapping are small areas of Kibbie and Milford soils. The somewhat poorly drained Kibbie soils are on slight rises. Milford soils have more clay in the subsoil than the Colwood soil. They are in small depressions. Also included, in depressions, are small areas of soils that have a surface layer of muck. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Colwood soil is near or above the surface during extended wet periods. Permeability is moderate. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth is good. The surface layer has a high content of organic matter.

Most areas are used as cropland. A few areas are used for specialty crops, such as carrots.

This soil is especially well suited to corn, soybeans, small grain, hay and pasture, and some specialty crops if a drainage system is installed. The seasonal wetness is the main management concern. 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. Grade-changing structures in areas where surface drains enter the deeper outlet ditches help to control erosion. A method of tillage that leaves a rough or ridged surface partly covered with crop residue hastens drying.

This soil is moderately well suited to trees. A few woodlots are mixed stands of native hardwoods. The seasonal wetness is the main management concern. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding is the main hazard. Properly grading building sites and septic tank absorption fields helps to keep surface water away from the foundations and the 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 foundations to allow for good drainage. Sloughing is a hazard in excavations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, low soil strength, and frost action. 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.

DeA—Del Rey silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises and low knolls on lake plains. Most areas range from 2 to 30 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 29 inches of yellowish brown, mottled, firm silty clay loam and silty clay. The underlying material to a depth of about 60 inches is yellowish brown, mottled, friable silt loam stratified with firm silty clay loam lacustrine sediment. In a few areas the subsoil has less clay.

Included with this soil in mapping are small areas of Fulton, Kibbie, Milford, and Shinrock soils. Fulton soils have more clay in the underlying material than the Del Rey soil. They are at the base of the slopes. Kibbie soils have a loamy surface layer. They are in landscape positions similar to those of the Del Rey soil. The very poorly drained Milford soils are in depressions and along drainageways. The moderately well drained Shinrock soils are on low knolls and side slopes. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Del Rey soil is in the upper part of the subsoil during extended wet periods. Permeability is slow. Surface runoff also is slow. The root zone is deep. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The 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. Deepening outlet ditches can improve the effectiveness of subsurface drains. Conservation tillage systems that leave crop residue on the surface, including no-till planting, reduce the hazard of sheet erosion and increase 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 minimize surface compaction.

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

This soil is moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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 moderately well suited to buildings and poorly suited to septic tank absorption fields. It is better suited to buildings without basements than to buildings with basements. The seasonal wetness and the slow permeability are the main limitations. Properly grading building sites helps to keep surface water away from foundations. 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. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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 4C.

Ee—Eel silt loam, occasionally flooded. This deep, nearly level, moderately well drained soil is on flood plains. In places the flood plains have numerous oxbows and meanders. The soil is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas range from 10 to 80 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The upper part of the underlying material is dark yellowish brown, friable silt loam and loam. The lower part to a depth of about 60 inches is yellowish brown, mottled, friable fine sandy loam stratified with sandy loam. The underlying material is mottled below a depth of about 28 inches. In some areas the surface layer is calcareous. In other areas it is very dark gray. In a few places gravelly or very gravelly sandy loam is below a depth of about 36 inches. In places the subsoil contains more silt.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils and the very poorly drained Sloan soils along old meander channels and in other depressions. These soils make up about 10 percent of most areas.

The seasonal high water table is in the middle and lower parts of the Eel soil during extended wet periods. Permeability is moderate. Surface runoff is slow. The root zone is deep. The available water capacity is high. The potential for frost action also is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

Figure 5.—Corn in an area of Eel silt loam, occasionally flooded. Glynwood clay loam, 6 to 12 percent slopes, eroded, is on the slope break in the background.

Most areas are used as woodland. Some areas are used as cropland. A few areas are used as pasture or are left as idle land.

This soil is well suited to corn (fig. 5), soybeans, and hay and pasture. It is suited to no-till planting if it is drained. Winter grain crops are usually not grown because of the hazard of flooding. Surface drains help to remove floodwater and permit earlier tillage and planting in spring. Random subsurface drains help to lower the seasonal high water table in areas of the wetter included soils. Controlling weeds is difficult because weed seeds are carried in by floodwater. Conservation tillage systems that leave the surface rough and partly covered with crop residue, including no-till planting, can reduce the amount of residue removed by floodwater. Winter cover crops protect the soil from scouring by floodwater. Stabilizing eroding streambanks is difficult in many areas. Clearing the channel of debris, grading the streambanks, and adding riprap or suitable plant material on the streambanks help to prevent excessive erosion.

Pasture rotation, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil generally is unsuited to buildings and septic tank absorption fields. The occasional flooding and the seasonal wetness are the main limitations. Roads, bridges, farm buildings, and other structures require special design to prevent the damage caused by floodwater. Fill material that elevates structures above the known high water level helps to prevent this damage. Installing a drainage system and replacing the base material help to prevent the damage to local roads and streets caused by frost action.

This soil is a good source of topsoil.

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

FoA—Fox silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil generally is on slight rises and low knolls on outwash plains and stream terraces. Most areas range from 5 to 20 acres in size and are oval or irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable and firm loam and clay loam, and the lower part is brown, firm gravelly clay loam. The underlying material to a depth of about 60 inches is brown, calcareous, loose gravelly sand. In some areas the subsoil has more clay and has a few gray mottles. In many areas the surface layer is loam. In a few places thin strata of sandy loam are in the underlying material.

Included with this soil in mapping are small areas of Kendallville, Ockley, Sleeth, and Westland soils. Kendallville soils are underlain by glacial till. They are near breaks to the uplands. Ockley soils have a solum that is thicker than that of the Fox soil. They are in landscape positions similar to those of the Fox soil. The somewhat poorly drained Sleeth soils and the very poorly drained Westland soils are on flats, along drainageways, and in depressions. Also included are a few small pits from which sand and gravel have been removed for local use. Inclusions make up about 10 percent of most areas.

Permeability is moderate in the subsoil of the Fox soil and rapid or very rapid in the underlying material. Surface runoff is slow. The root zone generally is moderately deep over sand and gravel. The available water capacity is moderate. Tilth is good. The surface layer has a moderately low content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting and to irrigation. Droughtiness is the main management concern. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature earlier in the growing season than to those that mature later. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration and conserve soil moisture. Returning crop residue to the soil and adding other organic material help to maintain good tilth, improve fertility, and conserve soil moisture. Plant nutrients are leached at a faster rate in this soil than in most of the other soils in the county. Consequently, crops generally respond better to smaller, more frequent or more timely applications of fertilizer and lime than to one large application.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. A moderate shrink-swell potential and pollution of ground water are the main limitations. Extending the foundations of buildings without basements and of small commercial buildings to the underlying material and backfilling along foundation walls with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Properly grading building sites helps to keep surface water away from foundations. Sloughing is a hazard in excavations. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action.

The effluent in septic tank absorption fields drains freely, but it can contaminate underground water supplies. Installing the absorption field in suitable fill material can improve the filtering capacity.

This soil is a probable source of sand and gravel.

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

FoB—Fox silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil generally is on low knolls and ridges on outwash plains and stream terraces. In a few areas it is on ridges and end moraines. Slopes are short, smooth, and irregular. Most areas range from 5 to 75 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is brown, firm clay loam, and the lower part is brown and dark reddish brown, firm gravelly sandy clay loam and gravelly clay loam. The underlying material to a depth of about 60 inches is yellowish brown, calcareous, loose very gravelly sand. In places the surface layer is loam. In some small areas the soil is eroded and has a thinner surface layer. In a few areas thin strata of sandy loam are in the underlying material. In many areas the subsoil has more clay.

Included with this soil in mapping are small areas of Kendallville, Morley, Ockley, Sleeth, and Westland soils. Kendallville and Morley soils are underlain by glacial till. They are on slope breaks to the uplands. Ockley soils have a solum that is thicker than that of the Fox soil. They are in landscape positions similar to those of the Fox soil. The somewhat poorly drained Sleeth soils and the very poorly drained Westland soils are in depressions and along drainageways. Also included are a few small pits from which sand and gravel have been removed for local use. Inclusions make up about 15 percent of most areas.

Permeability is moderate in the subsoil of the Fox soil and rapid or very rapid in the underlying material. Surface runoff is medium. The root zone generally is moderately deep over sand and gravel. The available water capacity is moderate. Tilth is good. The surface layer has a moderately low content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting and to irrigation. Erosion and droughtiness are the main management concerns. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature earlier in the growing season than to those that mature later. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration, conserve soil moisture, and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system also can help to control erosion. Returning crop residue to the soil and adding other organic material conserve soil moisture, help to maintain good tilth, and improve fertility. Plant nutrients are leached at a faster rate in this soil than in most of the other soils in the county. Consequently, crops generally respond better to smaller, more frequent or more timely applications of fertilizer and lime than to one large application.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. A moderate shrink-swell potential and pollution of ground water are the main limitations. Extending the foundations of buildings without basements and of small commercial buildings to the underlying material and backfilling along foundation walls with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Properly grading building sites helps to keep surface water away from foundations. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during final grading hasten the reestablishment of a plant cover. Sloughing is a hazard in excavations. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action.

The effluent in septic tank absorption fields drains freely, but it can contaminate underground water supplies. Installing the absorption field in suitable fill material can improve the filtering capacity.

This soil is a potential source of sand and gravel.

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

FpC2—Fox clay loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on outwash plains, kames, and stream terraces. It is on low knolls and on the side slopes of terraces along streams. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and subsoil material. Slopes generally are short and uneven. Most areas range from 5 to 20 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is brown, friable clay loam about 6 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, firm clay loam, and the lower part is dark yellowish brown, friable gravelly loam. The underlying material to a depth of about 60 inches is brown, calcareous, loose gravelly sand and very gravelly sand. In a few places thin strata of sandy loam are in the underlying material. In some areas the subsoil has more clay.

Included with this soil in mapping are small areas of Ockley, Sleeth, and Westland soils. Ockley soils have a solum that is thicker than that of the Fox soil. They are on the less sloping parts of the landscape. The somewhat poorly drained Sleeth soils and the very poorly drained Westland soils are in thin strips at the base of the slopes and along drainageways. Also included are a few sloping areas where the surface layer is severely eroded and has a few cobblestones and a few small pits from which sand and gravel have been removed for local use. Inclusions make up about 15 percent of most areas.

Permeability is moderate in the subsoil of the Fox soil and rapid or very rapid in the underlying material. Surface runoff is rapid. The root zone generally is moderately deep over sand and gravel. The available water capacity is low. Tilth is fair. The surface layer tends to crust after hard rains. It has a low content of organic matter.

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

This soil is poorly suited to corn, soybeans, and small grain and is moderately well suited to hay and pasture. It is well suited to no-till planting and to irrigation. Erosion and droughtiness are the main management concerns. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature earlier in the growing season than to those that mature later. Because of erosion, the soil is less productive and cannot be easily managed. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration, conserve soil moisture, and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system or delaying tillage until spring also can help to control erosion. Returning crop residue to the soil and adding other organic material can minimize surface crusting and improve tilth and fertility. Plant nutrients are leached at a faster rate in this soil than in most of the other soils in the county. Consequently, crops generally respond better to smaller, more frequent applications of fertilizer and lime than to one large application.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is moderately well suited to buildings and septic tank absorption fields. The slope, a moderate shrink-swell potential, and pollution of ground water are the main limitations. Buildings should not be constructed in areas where runoff from the adjacent soils concentrates. They 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. Extending the foundations of buildings without basements and of small commercial buildings to the underlying material and backfilling along foundation walls with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Sloughing is a hazard in excavations. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by shrinking and swelling and by frost action. Building the roads and streets on the contour helps to overcome the slope and reduces the hazard of erosion.

The effluent in septic tank absorption fields drains freely, but it can contaminate underground water supplies. Installing the absorption field in suitable fill material can improve the filtering capacity.

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

FuA—Fulton silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises on lake plains. Most areas range from 5 to 50 acres in size and are oval or irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 29 inches of yellowish brown, mottled, firm silty clay loam and silty clay. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm silty clay lacustrine sediment. In some areas the surface layer is loam. In places the underlying material is glacial till.

Included with this soil in mapping are small areas of Del Rey, Haskins, and Latty soils. Del Rey soils have less clay in the underlying material than the Fulton soil. They are in landscape positions similar to those of the Fulton soil. Haskins soils have less clay in the subsoil than the Fulton soil. They are along the edge of the mapped areas. Latty soils are very poorly drained and are in drainageways and depressions. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Fulton soil is perched in the upper part of the subsoil during extended wet periods. Permeability is slow or very slow. Surface runoff is slow. The root zone is deep. The available water capacity is moderate. The shrink-swell potential is high. The potential for frost action also is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. The seasonal wetness and a high content of clay 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. They generally are closely spaced because water moves into them at a slow rate. 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 minimize surface compaction.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting techniques that spread the roots of seedlings and improve the soil-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. 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 wetness, the slow or very slow permeability, and the 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 foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. 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 a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, shrinking and swelling, and frost action.

The limitations affecting septic tank absorption fields can be partially overcome by sand filter beds or by 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 can reduce the wetness.

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

FuB—Fulton silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on low knolls and side slopes along drainageways on lake plains. Most areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is yellowish brown and dark yellowish brown, mottled, firm silty clay about 26 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm and very firm silty clay lacustrine sediment. In some areas the underlying material is glacial till. In other areas the soil is eroded and has a thinner surface layer. In a few places the upper part of the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Del Rey, Haskins, Latty, and Shinrock soils. Del Rey and Haskins soils are on slope breaks and along drainageways. The very poorly drained Latty soils are in depressions and along drainageways. The moderately well drained Shinrock soils are on low knolls. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Fulton soil is perched in the upper part of the subsoil during extended wet periods. Permeability is slow or very slow. Surface runoff is medium. The root zone is deep. The available water capacity is moderate. The shrink-swell potential is high. The potential for frost action also is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. Erosion, seasonal wetness, and a high content of clay 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. They generally are closely spaced because water moves into them at a slow rate. A system of conservation tillage that leaves crop residue on the surface increases the rate of water infiltration and reduces the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Returning crop residue to the soil and adding other organic material minimize surface crusting and improve tilth and fertility. Tilling and harvesting at low soil moisture levels minimize surface compaction.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting techniques that spread the roots of seedlings and improve the soil-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. 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 wetness, the slow or very slow permeability, and the high shrink-swell potential are the main limitations. The soil is better suited to buildings without basements than to buildings with basements. 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 foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. 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 a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, shrinking and swelling, and frost action.

The limitations affecting septic tank absorption fields can be partially overcome by sand filter beds or by 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 IIIe. The woodland ordination symbol is 4C.

GwB—Glynwood silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on low knolls and ridges on till plains. Most areas range from 3 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 29 inches of yellowish brown, firm silty clay loam, silty clay, and clay loam. It is mottled below a depth of about 18 inches. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil and underlying material have less clay.

Included with this soil in mapping are small areas of Blount, Kendallville, and Pewamo soils. The somewhat poorly drained Blount soils are on the lower part of the slopes and in nearly level areas. The well drained Kendallville soils have a loamy subsoil. They are on the crest of knolls and on side slopes. The very poorly drained Pewamo soils are along drainageways and in depressions. Also included are some areas where the soil is eroded and has more clay in the surface layer. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Glynwood soil is perched in the lower part of the subsoil during extended wet periods. Permeability is slow. Surface runoff is medium. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting. Erosion is the main management concern. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling 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 minimize surface compaction. Random subsurface drains are needed in the wetter included soils.

Pasture rotation, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and moderately

Figure 6.—Erosion on a construction site in an area of Glynwood silt loam, 2 to 6 percent slopes.

well 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 (fig. 6). 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 foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. 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. Porous backfill material is needed to allow for good drainage. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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 IIe. The woodland ordination symbol is 4C.

GyB2—Glynwood clay loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on low knolls and ridges on till plains and on side slopes along streams. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas range from 5 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable clay loam about 6 inches thick. The subsoil is about 17 inches of dark yellowish brown, firm clay loam and clay. It is mottled below a depth of about 16 inches. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil and underlying material have less clay. In a few places the surface layer is silt loam.

Included with this soil in mapping are small areas of Blount, Kendallville, and Pewamo soils. The somewhat poorly drained Blount soils are on the lower part of the slopes and in nearly level areas. The well drained Kendallville soils have a loamy subsoil. They are on the crest of knolls and on side slopes. The very poorly drained Pewamo soils are along drainageways and in depressions. Also included are small areas of sloping soils in which tilth is poor. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Glynwood soil is perched in the lower part of the subsoil during extended wet periods. Permeability is slow. Surface runoff is medium. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. The potential for frost action is high. Because of erosion, tilth is only fair. The surface layer tends to crust after hard rains. It has a moderately low content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting. Erosion is the main management concern. Because of erosion, the soil is less productive and cannot be easily managed. No-till planting 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. Grassed waterways are effective in slowing concentrated runoff and in controlling 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 minimize surface compaction. Random subsurface drains are needed in the wetter included soils.

Pasture rotation, proper stocking rates, and deferment of grazing during extended periods of wetness or moisture stress help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the surface layer and subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to building site development and moderately well 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. Establishing a plant cover after construction may be difficult because of small stones and poor tilth. Properly grading building sites helps to keep surface water away from foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. 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. Porous backfill material is needed to allow for good drainage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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 IIIe. The woodland ordination symbol is 4C.

GyC2—Glynwood clay loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on fairly short slopes along small streams and on convex slopes in hummocky areas on till plains. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas range from 2 to 50 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is brown, firm clay loam about 8 inches thick. The subsoil is about 15 inches of yellowish brown, firm clay loam and silty clay. It is mottled below a depth of about 12 inches. The underlying material to a depth of about 60 inches is yellowish brown and brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil and underlying material have less clay. In a few places the soil is well drained.

Included with this soil in mapping are small areas of Belmore, Blount, Morley, and Pewamo soils. The well drained Belmore soils formed in glacial outwash. They are in some of the hummocky areas. The somewhat poorly drained Blount soils are on the lower part of the slopes and in seepy areas. The well drained Morley soils occur as thin strips and have slopes of 12 to 18 percent. The very poorly drained Pewamo soils are along drainageways and in depressions. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Glynwood soil is perched in the lower part of the subsoil during extended wet periods. Permeability is slow. Surface runoff is rapid. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. The potential for frost action is high. Because of erosion, tilth is only fair. The surface layer tends to crust after hard rains. It has a moderately low content of organic matter.

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

This soil is poorly suited to corn, soybeans, and small grain and is moderately well suited to hay and pasture. It is suited to no-till planting. Erosion is the main management concern. Because of erosion, the soil is less productive and cannot be easily managed. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling 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 minimize surface compaction. Random subsurface drains are needed in the wetter included soils.

Pasture rotation, proper stocking rates, and deferment of grazing during extended periods of wetness or moisture stress help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the surface layer and subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is moderately well suited to buildings and poorly suited to septic tank absorption fields. The wetness, the slope, the slow permeability, and a moderate shrink-swell potential are the main limitations. Buildings should be designed so that they conform to the natural slope of the land. Natural drainageways and the included seepy areas should not be used as building sites. Erosion is a hazard during construction. Establishing a plant cover after construction may be difficult because of poor tilth and small stones. Properly grading building sites helps to keep surface water away from foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. 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. Porous backfill material is needed for good drainage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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. Installing the distribution lines on the contour minimizes the seepage of effluent to the surface.

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

HkA—Haskins silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises and flats on ground moraines, end moraines, lake plains, and stream terraces. Most areas range from 3 to 15 acres in size and are irregularly shaped or long and narrow.

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

Included with this soil in mapping are small areas of Blount, Del Rey, Fulton, and Pewamo soils. Blount, Del Rey, and Fulton soils have more clay in the subsoil than the Haskins soil. They are in landscape positions similar to those of the Haskins soil. The very poorly drained Pewamo soils are in depressions and along drainageways. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Haskins soil is perched in the upper part of the subsoil during extended wet periods. Permeability is moderate in the upper part of the subsoil and slow or very slow in the underlying material. Surface runoff is slow. The root zone is moderately deep or deep over the moderately fine textured or fine textured underlying material. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The 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. They are more effective if they are installed on or above the less permeable underlying material. Conservation tillage systems that leave crop residue on the surface, including no-till planting, help to control erosion and increase 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 minimize surface compaction.

The pasture species selected for seeding 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. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is moderately well suited to buildings and poorly suited to septic tank absorption fields. The seasonal wetness and the slow or very slow permeability in the underlying material are the main limitations. Properly grading building sites helps to keep surface water away from foundations. 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. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by frost action.

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 can reduce the wetness.

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

HkB—Haskins silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on ground moraines, end moraines, lake plains, and stream terraces. In most areas it is on side slopes, low knolls, and ridges. Most areas range from 2 to 20 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 27 inches thick. The upper part is yellowish brown and dark yellowish brown, mottled, friable loam and sandy clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm and very firm clay loam glacial till. In some areas the surface layer is loam. In a few places the subsoil has more silt.

Included with this soil in mapping are small areas of Blount, Del Rey, and Glynwood soils. Blount and Del Rey soils have more clay in the subsoil than the Haskins soil. They are on low knolls and ridges. The moderately well drained Glynwood soils are on the crest of knolls. Also included are soils in convex areas on the crest of knolls. These soils are better drained than the Haskins soil. Included soils make up about 20 percent of most areas.

The seasonal high water table in the Haskins soil is perched in the upper part of the subsoil during extended wet periods. Permeability is moderate in the loamy upper part of the profile and slow or very slow in the moderately fine textured or fine textured underlying material. Surface runoff is medium. The root zone generally is moderately deep or deep over the moderately fine textured or fine textured underlying material. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The hazard of erosion and the 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. They are more effective if they are installed on or above the less permeable underlying material. Conservation tillage systems that leave crop residue on the surface, including no-till planting, help to control erosion and increase the rate of water infiltration. Including close-growing crops in the cropping system also helps to control erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Returning crop residue to the soil and adding other organic material help to maintain good tilth and improve fertility. Tilling and harvesting at low soil moisture levels minimize surface compaction.

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

This soil is well suited to woodland. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is moderately well suited to buildings and poorly suited to septic tank absorption fields. The wetness and the slow or very slow permeability in the underlying material 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 foundations. 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. Included areas of the moderately well drained Glynwood soils are better sites for buildings than this soil. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by frost action.

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 can reduce the wetness.

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

KaB—Kendallville silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on low knolls, ridges, and side slopes. In most areas it is on ground moraines, end moraines, and outwash plains. In a few areas it is on stream terraces. Most areas range from 5 to 30 acres in size and are narrow or irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, firm loam and clay loam, and the lower part is brown, firm gravelly sandy clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm clay loam glacial till. In a few places the surface layer is loam. In some small areas the soil is eroded and has a thinner surface layer. In a few areas the subsoil is thicker. In a few places the underlying material is silty clay.

Included with this soil in mapping are small areas of Glynwood, Haskins, Ockley, and Pewamo soils. The moderately well drained Glynwood soils are on the crest of knolls. They have more clay in the subsoil than the Kendallville soil. The somewhat poorly drained Haskins soils are on flats or in depressions. Ockley soils are underlain by sand and gravel. They are in landscape positions similar to those of the Kendallville soil. The very poorly drained Pewamo soils are in depressions and along drainageways. Included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Kendallville soil. Surface runoff is medium. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. Tilth is good. The surface layer has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting and to irrigation. Erosion and droughtiness are the main management concerns. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature earlier in the growing season than to those that mature later. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration, conserve soil moisture, and reduce the hazard of erosion. Including close-growing crops in the cropping system also helps to control erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Random subsurface drains are needed in the wetter included soils. Returning crop residue to the soil and adding other organic material conserve soil moisture and improve tilth and fertility.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. The moderately slow permeability and a moderate shrink-swell potential in the subsoil are the main limitations. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during final grading hasten the reestablishment of a plant cover. Backfilling along foundation walls with material that has a low shrink-swell potential helps to prevent the structural damage caused by shrinking and swelling. Strengthening or replacing the base material for buildings without basements, for small commercial buildings, and for local roads and streets can help to prevent the damage caused by shrinking and swelling and by frost action. 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.

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

KbA—Kibbie loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on ground moraines, end moraines, lake plains, and low knolls. Most areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is yellowish brown and brown, mottled, friable fine sandy loam and sandy clay loam, and the lower part is brown, mottled, friable clay loam and loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, firm silt loam that has thin strata of loam. In a few places the surface layer is silt loam. In places it is lighter in color. In a few areas the subsoil has more clay.

Included with this soil in mapping are small areas of Blount, Colwood, Haskins, and Milford soils. Blount and Haskins soils are underlain by glacial till and have a surface layer that is lighter colored than that of the Kibbie soil. They are in landscape positions similar to those of the Kibbie soil. The very poorly drained Colwood and Milford soils are in depressions and along drainageways. Also included are small areas of moderately well drained soils on the crest of knolls. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Kibbie soil is in the upper part of the subsoil during extended wet periods. Permeability is moderate. Surface runoff is slow. The root zone is deep. The available water capacity is high. The potential for frost action also is high. Tilth is good. The surface layer has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The 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. Conservation tillage systems that leave crop residue on the surface, including no-till planting, reduce the hazard of sheet erosion and increase the rate of water infiltration. Returning crop residue to the soil and adding other organic material help to maintain good tilth and improve fertility. Tilling and harvesting at low soil moisture levels minimize surface compaction.

The pasture species selected for seeding 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. Most woodlots are mixed stands of native hardwoods. Plant competition is the main management concern. It can be controlled by removing vines and the less desirable trees and shrubs.

This soil is moderately well suited to buildings and poorly suited to septic tank absorption fields. The seasonal wetness is the main limitation. Properly grading building sites helps to keep surface water away from foundations. 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. Sloughing is a hazard in excavations. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by frost action.

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 can reduce the wetness.

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

Figure 7.—An area of Latty silty clay loam on broad flats. The lighter colored Fulton soils are in the background.

La—Latty silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats on lake plains (fig. 7). Slope is 0 to 2 percent. Most areas range from 20 to 400 acres in size and are broad and irregularly shaped.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 10 inches thick. The subsoil is gray, dark gray, and grayish brown, mottled, firm and very firm silty clay about 48 inches thick. The underlying material to a depth of about 60 inches is olive brown, mottled, firm silty clay lacustrine sediment. In some areas the subsoil and underlying material have less clay. In other areas the surface layer is very dark gray.

Included with this soil in mapping are small areas of Fulton and Milford soils. The somewhat poorly drained Fulton soils are on slight rises. Milford soils are along drainageways and in depressions. They have a surface layer that is darker than that of the Latty soil and have less clay in the underlying material. Also included are a few areas where the surface layer is silty clay. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Latty soil is near or above the surface during extended wet periods. Permeability is very slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is moderate. The shrink-swell potential is high. Tilth is fair. The surface layer has a moderate content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. The seasonal wetness, surface compaction, and a high content of clay are the main management concerns. A drainage system is needed. 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. Subsurface drains generally are closely spaced because water moves into them at a slow rate. Deepening outlet ditches can improve the effectiveness of subsurface drainage systems. In some areas outlets are ineffective during periods of flooding in the surrounding rivers and streams. Fall tillage often improves tilth and minimizes the need for spring tillage. 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 minimize surface compaction.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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 generally is unsuited to buildings and septic tank absorption fields. The ponding, the very slow permeability, and the high shrink-swell potential are the major limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, shrinking and swelling, and low soil strength.

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

Le—Latty silty clay. This deep, nearly level, very poorly drained soil is on broad flats on lake plains. Slope is 0 to 2 percent. Most areas range from 20 to 200 acres in size and are broad and irregularly shaped.

Typically, the surface layer is dark gray, firm silty clay about 9 inches thick. The subsoil is gray, mottled, very firm silty clay about 35 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, very firm silty clay lacustrine sediment. In some areas the upper part of the subsoil is strongly acid or very strongly acid. In a few areas the subsoil has more clay.

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

The seasonal high water table in the Latty soil is near or above the surface during extended wet periods. Permeability is very slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is moderate. The shrink-swell potential is high. Tilth is fair. The surface layer has a moderate content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. The seasonal wetness, surface compaction, crusting (fig. 8), and a high content of clay are the main management concerns. The surface layer cracks as it dries out following a prolonged period of rainfall. A drainage system is needed. 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. Subsurface drains generally are closely spaced because water moves into them at a slow rate. Deepening outlet ditches can improve the effectiveness of subsurface drainage systems. In some areas outlets are ineffective during periods of flooding in the surrounding rivers and streams. Fall tillage often improves tilth and minimizes the need for spring tillage. 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 minimize surface compaction.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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 generally is unsuited to buildings and septic tank absorption fields. The ponding, the very slow permeability, and the high shrink-swell potential are the major limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, shrinking and swelling, and low soil strength.

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

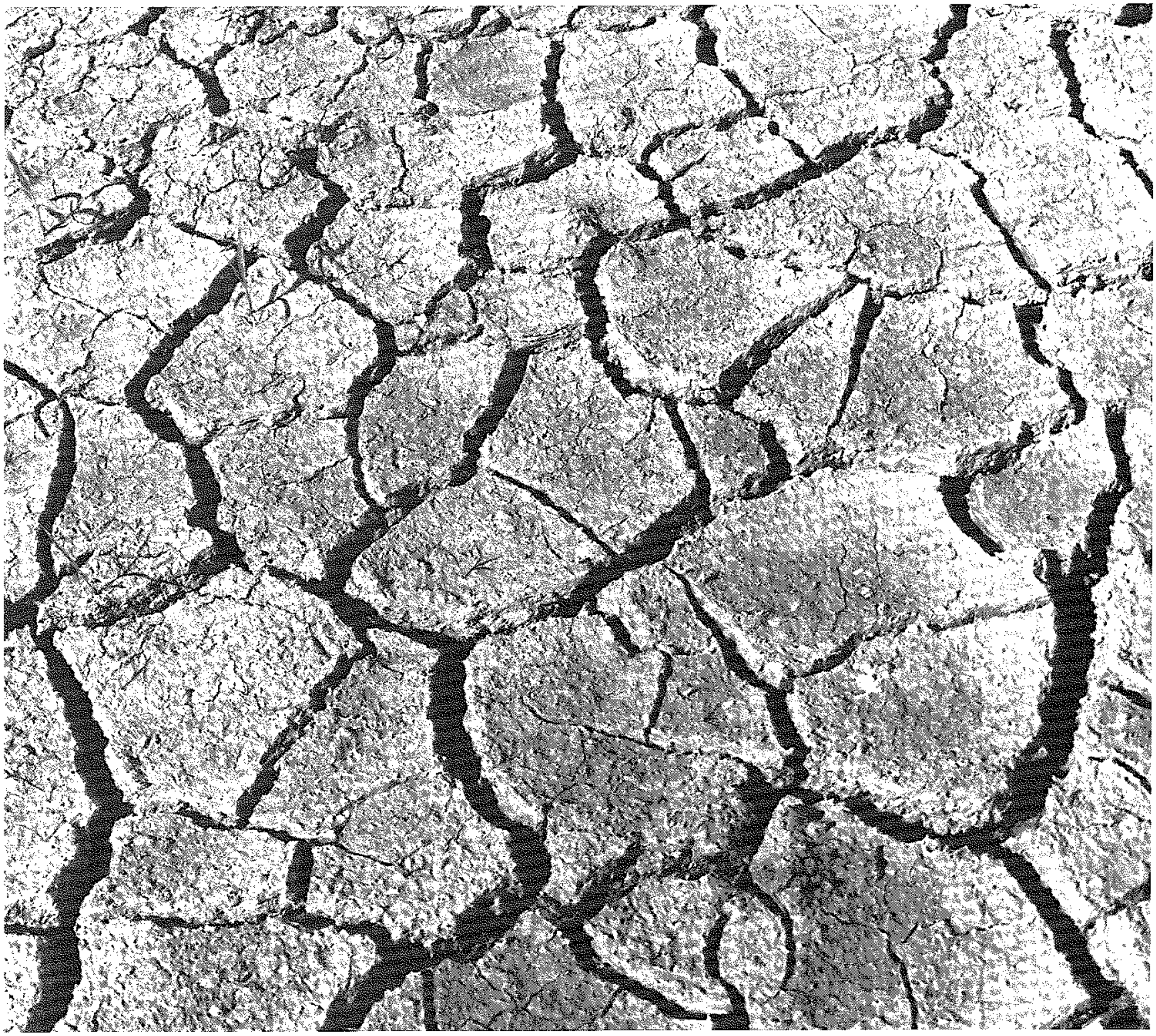

Figure 8.—A crusted surface in an area of Latty silty clay.

Ln—Linwood muck. This deep, level, very poorly drained soil generally is in low areas on lake plains. In a few areas, however, it is in depressions on till plains and outwash plains. Slope is 0 to 1 percent. Most areas range from 5 to 200 acres in size and are broad and irregularly shaped.

Typically, the surface layer is black, friable muck about 11 inches thick. The subsurface layer is dark reddish brown, friable muck about 7 inches thick. The next layer is dark grayish brown, firm coprogenous earth (sedimentary peat) about 9 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, friable silt loam. In some areas the underlying material is marl. In a few areas the layer of coprogenous earth is thicker.

Included with this soil in mapping are small areas of Carlisle and Roundhead soils. These soils are in landscape positions similar to those of the Linwood soil.

Carlisle soils have more than 51 inches of muck. Roundhead soils have less than 16 inches of muck. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Linwood soil is near or above the surface during extended wet periods. Permeability is moderately slow to moderately rapid in the organic material and moderately slow or moderate in the underlying material. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is very high. The potential for frost action is high. Tilth is good. The surface layer has a very high content of organic matter.

Nearly all areas have been drained and are used as cropland. A few areas are used as pasture or are left as idle land.

Drained areas of this soil are well suited to corn and soybeans and to specialty crops, such as carrots and potatoes. The seasonal wetness, soil blowing, and subsidence are the main management concerns. Cultivated crops can be grown year after year if optimum management is applied. A drainage system is needed. Subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. Subsidence or shrinkage, which occurs as a result of oxidation of the organic material after the soil is drained, sometimes causes displacement of subsurface drains. Control of the water table by subirrigation through tile lines reduces the hazards of subsidence, burning, and soil blowing. Planting winter cover crops, delaying tillage until spring, and establishing windbreaks reduce the hazard of soil blowing. The soil can be easily tilled. The surface layer commonly requires compaction rather than loosening when a good seedbed is prepared. The soil readily absorbs water, nutrients, and pesticides because of the very high content of organic matter. Because of the low position on the landscape, plants are more susceptible to frost on this soil than on the nearby mineral soils.

This soil generally is unsuited to trees. The wetness is the main management concern. The trees can be logged during the drier parts of the year or when the soil is frozen. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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.

A few undrained areas of this soil are well suited to habitat for wetland wildlife. In these areas the soil supports water-tolerant trees, cattails, reeds, and sedges.

In the larger areas of this soil, windbreaks are needed to control soil blowing. Selecting the species of trees and shrubs that are tolerant of wetness can reduce the seedling mortality rate. Fast-growing species that have desirable growth characteristics provide adequate protection. The trees and shrubs should be planted at right angles to the prevailing wind.

This soil generally is unsuited to buildings and septic tank absorption fields. The moderately slow permeability, ponding, subsidence, and low soil strength are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, subsidence, and frost action.

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

MaB—Martinsville loam, 1 to 4 percent slopes. This deep, gently sloping, well drained soil generally is on low knolls and ridges on outwash plains, on stream terraces, and along the margin of lake plains. In a few areas, however, it is on moraines. Most areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable loam about 10 inches thick. The subsoil is about 49 inches thick. The upper part is dark yellowish brown, friable and firm sandy clay loam and clay loam, and the lower part is dark yellowish brown, friable sandy clay loam, loam, sandy loam, and silt loam. The underlying material to a depth of about 70 inches is yellowish brown and grayish brown, very friable, stratified silt loam, fine sandy loam, and loamy fine sand. In places the soil has more silt and less sand throughout. In some areas the lower part of the subsoil has gray mottles. In a few areas the soil has layers in which the content of gravel is more than 15 percent.

Included with this soil in mapping are small areas of Kendallville, Kibbie, and Milford soils. Kendallville soils are underlain by glacial till. They are on the crest of knolls. The somewhat poorly drained Kibbie soils and the very poorly drained Milford soils are along drainageways, in depressions, and along the margin of the mapped areas. They have a surface layer that is darker than that of the Martinsville soil. Also included, on lake plains, are a few small areas of soils in which the underlying material is sandy clay or clay. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Martinsville soil. Surface runoff is slow or medium. The root zone is deep. The available water capacity is high. Tilth is good. The surface layer has a moderately low content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting and to irrigation. Erosion and droughtiness are the main management concerns. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature earlier in the growing season than to those that mature later. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration, conserve soil moisture, and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system also helps to control erosion. Returning crop residue to the soil and adding other organic material conserve soil moisture, help to maintain good tilth, and improve fertility. Random subsurface drains are needed in areas of the wetter included soils.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition is the main management concern. It can be controlled by removing vines and the less desirable trees and shrubs.

This soil is well suited to buildings and septic tank absorption fields. A moderate shrink-swell potential in the subsoil is a limitation on sites for buildings without basements and for small commercial buildings. Extending foundations to the underlying material and backfilling along foundation walls with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Properly grading building sites helps to keep surface water away from foundations. Erosion is a hazard during construction. Stockpiling the surface soil and then spreading it during final grading hasten the reestablishment of a plant cover. Sloughing is a hazard in excavations. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by frost action and by shrinking and swelling of the subsoil.

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

Mc—McGuffey muck. This deep, level, very poorly drained soil generally is on broad flats on lake plains and in marshes. In a few areas, however, it is in depressions on till plains and outwash plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is less than 1 percent. Most areas range from 10 to more than 500 acres in size and are irregularly shaped.

Typically, the surface layer is black, very friable muck about 10 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, calcareous, very firm silty clay about 23 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, calcareous, very firm silty clay lacustrine sediment. In some areas the organic layer is thicker. In a few places the upper part of the subsoil is more acid. In a few areas the lower part of the underlying material is glacial till.

Included with this soil in mapping are small areas of Montgomery, Pewamo Variant, and Roundhead soils. Montgomery soils have a surface layer of silty clay loam and are in the slightly higher positions on the landscape. Pewamo Variant and Roundhead soils are in landscape positions similar to those of the McGuffey soil. Pewamo Variant soils formed in glacial till. Roundhead soils formed in silty lacustrine sediment. Included soils make up about 5 percent of most areas.

The seasonal high water table in the McGuffey soil is near or above the surface during extended wet periods. Permeability is very slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is moderate or high. The shrink-swell potential is high. Tilth is good. The surface layer has a very high content of organic matter.

Nearly all areas have been drained and are used as cropland. This soil is moderately well suited to corn, soybeans, small grain, hay and pasture, and some specialty crops. The ponding and the hazard of soil blowing are the main management concerns. A drainage system is needed. Surface and subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. Subsurface drains generally are closely spaced because water moves into them at a slow rate. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. Deepening the outlet ditches can improve the effectiveness of subsurface drainage systems. In some areas outlets are ineffective during periods of flooding in the surrounding rivers and ditches. Pumping stations can reduce the amount of time that ponded water stands in fields. Subsidence and shrinkage occur as a result of oxidation in the organic material after the soil is drained. During dry periods the soil is subject to soil blowing. Planting cover crops, returning crop residue to the soil, irrigating, and establishing windbreaks can reduce the hazard of soil blowing. Fire is a hazard during dry periods. In some areas, the surface layer is calcareous and the soil is deficient in manganese. Applying excessive amounts of lime can worsen this deficiency. Crops grown on this soil are subject to early season frost damage because of the low position on the landscape.

In the larger areas of this soil, windbreaks are needed to control soil blowing. Selecting the species of trees and shrubs that are tolerant of wetness and a high content of clay in the subsoil can reduce the seedling mortality rate. Fast-growing species that have desirable growth characteristics provide adequate protection. Plant competition can be controlled by removing the less desirable trees and shrubs. The trees and shrubs should be planted at right angles to the prevailing wind.

This soil generally is unsuited to buildings and septic tank absorption fields. The ponding, the slow or very slow permeability in the lacustrine material, and the high shrink-swell potential are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, shrinking and swelling, and low soil strength.

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

Mf—Milford silty clay loam. This deep, nearly level, very poorly drained soil generally is on broad flats, in shallow, closed depressions, and along minor drainageways on lake plains. In a few areas, however, it is in some of the deeper closed depressions on till plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 5 to more than 1,000 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, firm silty clay loam about 10 inches thick. The subsoil is about 43 inches thick. The upper part is very dark grayish brown and dark gray, mottled, firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. The underlying material to a depth of about 60 inches is gray, mottled, firm silty clay loam lacustrine sediment that has strata of silt loam. In a few areas the surface layer is thinner.

Included with this soil in mapping are small areas of Del Rey, Montgomery, and Pewamo soils. The somewhat poorly drained Del Rey soils are on slight rises. Montgomery soils have more clay in the underlying material than the Milford soil. They are in the center of depressions. Pewamo soils are underlain by glacial till. They are along the periphery of the mapped areas. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Milford soil is near or above the surface during extended wet periods. Permeability is moderately slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth is fair. The surface layer has a high content of organic matter.

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

This soil is especially well suited to corn, soybeans, small grain, and hay and pasture if a drainage system is installed. The seasonal wetness and surface compaction are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in spring. In some areas drainage outlets are ineffective during periods of flooding in the surrounding ditches and streams. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. Grassed waterways can help to slow and direct the movement of water in some areas. A method of tillage that leaves a rough or ridged surface partly covered with crop residue hastens drying. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction.

The pasture species selected for seeding 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 poorly suited to buildings and septic tank absorption fields. The ponding and the moderately slow permeability are the main limitations. Properly grading building sites and septic tank absorption fields help to keep surface water away from the foundations and the 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 foundations to allow for good drainage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, ponding, and frost action.

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. No woodland ordination symbol is assigned.

Mk—Millsdale silty clay loam. This moderately deep, nearly level, very poorly drained soil is in depressions and along drainageways on till plains and low stream terraces. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 5 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, firm silty clay loam about 14 inches thick. The subsoil is dark gray, mottled, firm silty clay loam about 21 inches thick. Light gray, hard limestone bedrock is at a depth of about 35 inches. In some areas the depth to limestone bedrock is 40 to 60 inches, and in a few areas it is less than 20 inches.

Included with this soil in mapping are small areas of Blount, Milton, Pewamo, and Sloan soils. The deep, somewhat poorly drained Blount soils and the well drained Milton soils are on slight rises. The deep Pewamo soils are near the periphery of the mapped areas. The deep, frequently flooded Sloan soils are along streams. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Millsdale soil is perched near or above the surface during extended wet periods. Permeability is moderately slow. Surface runoff is very slow or ponded. The root zone is moderately deep over limestone bedrock. The available water capacity is moderate or low. The shrink-swell potential is high. The potential for frost action also is high. Tilth is fair. The surface layer has a high content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. The seasonal wetness and surface compaction are the main management concerns. A drainage system is needed. 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 tile gradients are restricted by the depth to bedrock. Deepening outlet ditches can improve the effectiveness of subsurface drainage systems. Establishing drainage outlets is difficult, however, in many areas where bedrock is at a depth of 20 to 40 inches. In some areas the outlets are ineffective during periods of flooding in the surrounding ditches and streams. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Grassed waterways can help to slow and direct the movement of water in some areas.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil generally is unsuited to buildings and septic tank absorption fields. The ponding, the high shrink-swell potential, the moderately slow permeability, seepage, and the depth to bedrock are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, ponding, and shrinking and swelling.

This soil is a good source of limestone.

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

Mo—Montgomery silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats on lake plains and in deep, closed depressions on till plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 5 to 100 acres in size and are irregularly shaped or roughly circular.

Typically, the surface layer is black, firm silty clay loam about 10 inches thick. The subsoil is about 29 inches thick. The upper part is very dark gray and gray, mottled, firm silty clay, and the lower part is gray, mottled, firm silty clay and silty clay loam. The underlying material to a depth of about 60 inches is olive brown, mottled, firm silty clay loam. In a few areas glacial till is at a depth of 40 to 60 inches. In some areas the surface layer is lighter colored.

Included with this soil in mapping are small areas of Blount, McGuffey, Milford, and Pewamo soils. The somewhat poorly drained Blount soils formed in glacial till on slight rises adjacent to uplands. Their surface layer is lighter colored than that of the Montgomery soil. McGuffey soils have a surface layer of muck. They are in the center of depressions. Milford soils have less clay throughout than the Montgomery soil. They are in landscape positions similar to those of the Montgomery soil. Pewamo soils are underlain by glacial till. They occur as thin strips along the periphery of the mapped areas.

The seasonal high water table in the Montgomery soil is near or above the surface during extended wet periods. Permeability is slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is high. The shrink-swell potential and the potential for frost action also are high.

Tilth is fair. The surface layer has a high content of organic matter.

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

This soil is moderately well suited to corn, soybeans, small grain, and hay and pasture. The seasonal wetness, surface compaction, and a high content of clay throughout the profile are the main management concerns. A drainage system is needed. 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. Subsurface drains should be closely spaced because water moves into them at a slow rate. Deepening outlet ditches improves the effectiveness of these drains. Compaction is a serious problem if the soil is tilled or crops are planted or harvested during wet periods. Fall tillage commonly improves tilth and minimizes the need for spring tillage. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Including deep-rooted meadow crops in the cropping system improves soil structure.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. Planting seedlings that have been transplanted once and that are tolerant of wetness reduces the seedling mortality rate. Frequent, light thinning and harvesting 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. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is generally unsuited to buildings and septic tank absorption fields. The ponding, the slow permeability, and the high shrink-swell potential are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, ponding, and shrinking and swelling.

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

Mp—Montgomery silty clay loam, gravelly substratum. This deep, nearly level, very poorly drained soil is in depressions on slack water terraces and outwash plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 10 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is black, firm silty clay loam about 11 inches thick. The subsoil is about 34 inches thick. The upper part is very dark gray and dark gray, mottled, firm silty clay; the next part is dark gray and olive gray, mottled, firm silty clay; and the lower part is dark gray and dark grayish brown, mottled, friable clay loam and gravelly clay loam. The underlying material to a depth of about 60 inches is dark grayish brown, loose gravelly sandy loam stratified with sandy loam and gravelly loamy sand. In a few places the underlying material is silt loam or silty clay loam.

Included with this soil in mapping are small areas of Sleeth and Westland soils. The somewhat poorly drained Sleeth soils are on low knolls and ridges. Westland soils have less clay in the upper part of the subsoil than the Montgomery soil. They are in landscape positions similar to those of the Montgomery soil. Also included, in depressions, are small areas of soils that have a surface layer of mucky silt loam. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Montgomery soil is near or above the surface during extended wet periods. Permeability is slow in the subsoil and moderately rapid or rapid in the underlying material. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is moderate. The shrink-swell potential is high in the upper part of the subsoil. The potential for frost action is high. Tilth is fair. The surface layer has a high content of organic matter.

Nearly all areas have been drained and are used as cropland. This soil is well suited to corn, soybeans, small grain, and hay and pasture. The seasonal wetness and surface compaction are the main management concerns. A drainage system is needed. 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 minimize surface compaction.

The pasture species selected for seeding 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 poorly suited to buildings and septic tank absorption fields. The ponding, the slow permeability, and the high shrink-swell potential in the subsoil are the main limitations. The soil is better suited to buildings without basements than to buildings with basements. Properly grading building sites and septic tank absorption fields helps to keep surface water away from the foundations and the absorption fields. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Extending the foundations of buildings without basements and of small commercial buildings to the underlying material helps to prevent the structural damage caused by shrinking and swelling. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength, ponding, and shrinking and swelling.

The limitations affecting septic tank absorption fields can be partially overcome by sand filter beds or by 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. No woodland ordination symbol is assigned.

MrD2—Morley clay loam, 12 to 18 percent slopes, eroded. This deep, moderately steep, well drained soil is on short slopes along streams and on knolls and convex slopes in hummocky areas on till plains. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas range from 5 to 30 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is brown, firm clay loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 27 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, very firm clay loam glacial till. In some areas the lower part of the subsoil and the underlying material have less clay. In a few areas the surface layer is silty clay loam. In places the lower part of the subsoil has a few gray mottles. In many areas the surface layer and subsoil are thinner.

Included with this soil in mapping are small areas of Belmore, Blount, and Kendallville soils. Belmore soils formed in glacial outwash. They are in some of the hummocky areas. The somewhat poorly drained Blount soils are in seepy areas on the lower part of side slopes and along drainageways. Kendallville soils have less clay in the subsoil than the Morley soil. They are on side slopes and the crest of knolls. Also included are small areas of severely eroded soils that have slopes of 18 to 40 percent. Included soils make up about 15 percent of most areas.

Permeability is moderately slow or slow in the Morley soil. Surface runoff is very rapid. The root zone generally is moderately deep over compact glacial till. The available water capacity is moderate. Because of erosion, tilth is only fair. The surface layer has a moderately low content of organic matter. A crust forms on the surface after hard rains.

Most areas are used as cropland. Some areas are used as pasture or are left as idle land. A few areas are wooded.

This soil is poorly suited to corn, soybeans, and small grain and is moderately well suited to hay and pasture. In some areas it is suited to no-till planting. Erosion is the main management concern. Because of erosion, the soil is less productive and cannot be easily managed. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling 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 minimize surface compaction. Random subsurface drains are needed in the wetter included soils.

Pasture rotation, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep pastures in good condition.

This soil is well suited to trees and to habitat for openland and woodland wildlife. Most woodlots are mixed stands of native hardwoods. 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. A good plant cover also helps to control erosion. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is poorly suited to buildings and septic tank absorption fields. The slope and the moderately slow or slow permeability are the main limitations. Natural drainageways and seepy areas should not be used as building sites. Erosion is a hazard during construction. Establishing a plant cover after construction may be difficult because of small stones and poor tilth. Properly grading building sites helps to keep surface water away from foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Building local roads and streets on the contour helps to overcome the slope and reduces the hazard of erosion. Strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength.

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. Installing the distribution lines on the contour minimizes the seepage of effluent to the surface.

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

MsC2—Morley-Belmore complex, 6 to 15 percent slopes, eroded. These deep, sloping, well drained soils are on knolls, ridges, and side slopes on outwash terraces, kames, and end moraines. Slopes commonly are short and irregular and in many areas are dissected by short drainageways. Erosion has removed part of the original surface layer. The present surface layer is a mixture of the original surface layer and subsoil material. Most areas range from 5 to 30 acres in size and are oval or irregularly shaped.

This map unit is about 65 percent Morley clay loam and 20 percent Belmore loam. The two soils occur as areas so small or so intricately mixed that mapping them separately was not practical.

Typically, the surface layer of the Morley soil is brown, firm clay loam about 8 inches thick. The subsoil is dark yellowish brown, firm clay loam about 27 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, very firm clay loam glacial till. In some areas the subsoil has less clay. In a few areas the lower part of the subsoil has gray mottles. In many areas the surface layer is thinner.

Typically, the surface layer of the Belmore soil is dark brown, friable loam about 8 inches thick. The subsoil is about 34 inches of brown and dark yellowish brown, firm and friable clay loam and gravelly loam. The underlying material to a depth of about 80 inches is yellowish brown and dark yellowish brown, firm and friable loam and gravelly loam having a stratum of friable fine sandy loam. In a few small areas the surface layer is gravelly loam or gravelly clay loam. In places it is thinner. In many areas the subsoil is thicker.

Included with these soils in mapping are small areas of Blount, Fox, and Kendallville soils. The somewhat poorly drained Blount soils are in drainageways and along the base of the slopes. Fox soils have less clay in the underlying material than the Belmore soil. They are in landscape positions similar to those of the Belmore soil. Kendallville soils have loamy outwash in the upper part and are underlain by glacial till within a depth of 40 inches. They are on the crest of knolls and in convex areas on side slopes. Included soils make up about 15 percent of most areas.

Permeability is moderately slow or slow in the Morley soil and moderately rapid in the Belmore soil. Surface runoff is rapid on the Morley soil and medium or rapid on the Belmore soil. The root zone generally is moderately deep over compact glacial till in the Belmore soil and is deep in the Belmore soil. The available water capacity is moderate in both soils. Tilth is fair. The content of organic matter is moderately low. A crust forms on the surface of the Morley soil after hard rains.

Most areas are used as cropland or permanent pasture. A few areas are wooded or are left as idle land.

These soils are poorly suited to corn and soybeans and are moderately well suited to winter grain and to hay and pasture. They are well suited to no-till planting. Erosion and droughtiness are the main management concerns. Because of erosion, the soils are less productive and cannot be easily managed. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration, conserve soil moisture, and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system can help to control erosion. The soils dry early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soils are better suited to crops that mature early than to those that mature late in summer. Returning crop residue to the soils and adding other organic material can minimize surface crusting, improve tilth, increase the rate of water infiltration, and conserve soil moisture.

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

These soils are well suited to woodland. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

Because of the moderately slow or slow permeability and a moderate shrink-swell potential, the Morley soil is only moderately well suited to buildings and is poorly suited to septic tank absorption fields. The Belmore soil is better suited to these uses because it has less clay than the Morley soil and is moderately rapidly permeable. The slope is the main limitation in areas of the Belmore soil. Buildings should be designed so that they conform to the natural slope of the land. They should be constructed away from the direct line of runoff. 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 of the Morley soil. Porous backfill material is needed to allow for good drainage. Maintaining a plant cover during construction reduces the hazard of erosion on both soils. Adding a cover of good topsoil can hasten the establishment of lawns. Strengthening and replacing the base material can help to prevent the damage to local roads and streets caused by low strength in the Morley soil. Building the roads and streets on the contour helps to overcome the slope and reduces the hazard of erosion.

In areas of the Morley soil, 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. Installing the distribution lines on the contour minimizes the seepage of effluent to the surface.

The land capability classification is IVe. The woodland ordination symbol is 4A in areas of the Morley soil and 4R in areas of the Belmore soil.

MtB—Morley-Milton silt loams, 2 to 6 percent slopes. These gently sloping, well drained soils are on ridges and knolls on till plains. The Morley soil is deep, and the Milton soil is moderately deep. Slopes generally are irregular and in many areas are dissected by small drainageways. Most areas range from 5 to 50 acres in size and are wide and irregularly shaped.

This map unit generally is about 60 percent Morley silt loam and 30 percent Milton silt loam. The two soils occur as areas so small or so intricately mixed that mapping them separately was not practical.

Typically, the surface layer of the Morley soil is brown, friable silt loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is dark yellowish brown, firm silty clay loam, and the lower part is yellowish brown, firm silty clay and clay loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled, calcareous, very firm clay loam glacial till.

Typically, the surface layer of the Milton soil is brown, friable silt loam about 7 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, firm silty clay loam; the next part is brown and dark yellowish brown, firm clay; and the lower part is yellowish brown, firm silty clay loam and clay loam. Light gray, hard limestone bedrock is at a depth of about 33 inches. In a few areas the depth to limestone bedrock is 40 to 60 inches.

Included with these soils in mapping are small areas of Blount, Millsdale, and Pewamo soils. The somewhat poorly drained Blount soils are in nearly level areas and depressions. The very poorly drained Millsdale and Pewamo soils are along drainageways. Also included are a few areas of sloping soils on side slopes along drainageways. Included soils make up about 10 percent of most areas.

Permeability is slow or moderately slow in the Morley soil and moderate or moderately slow in the Milton soil. Surface runoff is medium on both soils. The root zone is moderately deep over glacial till in the Morley soil and moderately deep over limestone bedrock in the Milton soil. The available water capacity is moderate in the Morley soil and low in the Milton soil. Tilth generally is good unless the soils are tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

These soils are well suited to corn, soybeans, small grain, and hay and pasture. They are well suited to no-till planting. Erosion is the main management concern. Droughtiness is an additional management concern on the Milton soil because of the limited root zone and available water capacity. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system or delaying tillage until spring also reduces the hazard of erosion. Returning crop residue to the soils and adding other organic material minimize surface crusting, help to maintain good tilth, and improve fertility. Tilling and harvesting at low soil moisture levels minimize surface compaction. Where possible, random subsurface drains should be installed in the wetter included soils.

Pasture rotation, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress help to keep pastures in good condition.

These soils are well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

These soils are moderately well suited to buildings and are moderately well suited or poorly suited to septic tank absorption fields. The restricted permeability, a moderate shrink-swell potential, seepage, and the depth to bedrock are the main limitations. Onsite investigation generally is necessary to identify the kind of soil and the suitability of a site prior to construction. The deep Morley soil is a better site for buildings with basements than the moderately deep Milton soil. Blasting of the bedrock underlying the Milton soil would be needed. 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 foundations. 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. Strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength.

The depth to bedrock and seepage in areas of the Milton soil and the restricted permeability in both soils are limitations on sites for septic tank absorption fields. The Morley soil is a better site than the Milton soil. The restricted permeability can be partially overcome by increasing the size of the absorption area. The effluent from sanitary facilities can move through fissures in the limestone bedrock underlying the Milton soil and contaminate underground water supplies.

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

Ne—Newark silt loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. It generally is in flat areas or slight depressions on the lowest parts of the landscape. In places the flood plains have numerous oxbows and meanders. The soil is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas range from 10 to 40 acres in size and are long and narrow.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 35 inches of yellowish brown, grayish brown, and gray, mottled, friable and firm silt loam and silty clay loam. The underlying material to a depth of about 60 inches is dark gray, mottled, firm silty clay loam alluvium. In some areas the soil has more sand. In a few areas it is moderately well drained. In places glacial till is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Nolin and Saranac soils. The well drained Nolin soils are commonly in the slightly higher positions on the landscape. The very poorly drained Saranac soils are in enclosed depressions and old meander channels. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Newark soil is in the upper part of the subsoil during extended wet periods. Permeability is moderate. Surface runoff is slow. The root zone is deep. The available water capacity is high. The potential for frost action also is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

Most areas are used as cropland. Some areas are used as pasture or are left as idle land. A few areas are wooded.

This soil is well suited to corn, soybeans, and hay and pasture. It is suited to no-till planting if it is drained. Winter grain crops commonly are not grown because of the hazard of flooding. The occasional flooding and the seasonal wetness are the main management concerns. Keeping stream channels free of obstructions, such as logjams, reduces the hazard of flooding. 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 many areas establishing adequate drainage outlets is difficult. The outlets are ineffective during periods of flooding in the surrounding rivers and streams. Conservation tillage systems that leave the surface rough and partly covered with crop residue, including no-till planting, can reduce the amount of residue removed by floodwater. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Winter cover crops protect the soil from scouring by floodwater. Controlling weeds is difficult because weed seeds are carried in by floodwater. Stabilizing eroding streambanks is difficult in many areas. Clearing the channel of debris, grading the streambanks, and adding riprap or suitable plant material on the streambanks help to prevent excessive erosion.

The pasture species selected for seeding 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 moderately well suited to trees and to habitat for openland and woodland wildlife. Most woodlots are mixed stands of native hardwoods. The occasional flooding and the seasonal wetness are the main management concerns. The trees can be logged when the soil is frozen or during the drier parts of the year. Frequent, light thinning and harvesting can increase the vigor of the stand. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil generally is unsuited to buildings and septic tank absorption fields. The occasional flooding and the seasonal wetness are the main limitations. Roads, bridges, farm buildings, and other structures require special design to prevent the damage caused by floodwater. Fill material that elevates structures above the known high water level helps to prevent this damage. Installing a drainage system and replacing the base material help to prevent the damage to local roads and streets caused by wetness and frost action.

This soil is a good source of topsoil.

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

No—Nolin silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. It generally is in flat areas on the lowest parts of the landscape. In places the flood plains have numerous oxbows and meanders. The soil is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas range from 10 to 300 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 18 inches thick. The subsoil is about 29 inches of brown, friable silt loam and silty clay loam. The underlying material to a depth of about 60 inches is yellowish brown, friable silty clay loam alluvium. In a few areas the soil is moderately well drained. In some areas the surface layer is darker. In places the subsoil has more sand.

Included with this soil in mapping are small areas of Fox, Martinsville, Newark, and Saranac soils. Fox and Martinsville soils formed in glacial outwash. They are on slight rises. The somewhat poorly drained Newark soils and the very poorly drained Saranac soils are along old meander channels and in other depressions. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Nolin soil is in the lower part of the subsoil during extended wet periods. Permeability is moderate. Surface runoff is slow. The root zone is deep. The available water capacity is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, and hay and pasture. It is well suited to no-till planting. Winter grain crops commonly are not grown because of the hazard of flooding. Keeping stream channels free of obstructions, such as logjams, reduces the hazard of flooding. Surface drains help to remove floodwater and permit earlier tillage and planting in spring. Conservation tillage systems that leave the surface rough and partly covered with crop residue, including no-till planting, can reduce the amount of residue removed by floodwater. Winter cover crops protect the soil from scouring by floodwater. Stabilizing eroding streambanks is difficult in many areas. Clearing the channel of debris, grading the streambank, and adding riprap or suitable plant material on the streambanks help to prevent excessive erosion. Controlling weeds is difficult because weed seeds are carried in by floodwater.

Pasture rotation, proper stocking rates, and deferred grazing when the soil is wet help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. The occasional flooding and plant competition are the main management concerns. The trees can be logged during the drier parts of the year. Plant competition can be controlled by removing vines and the less desirable trees and shrubs.

This soil generally is unsuited to buildings and septic tank absorption fields. The occasional flooding is the main hazard. Roads, bridges, farm buildings, and other structures require special design to prevent the damage caused by floodwater. Fill material that elevates structures above the known high water level helps to prevent this damage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by wetness.

This soil is a good source of topsoil.

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

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

Typically, the surface layer is brown, friable loam about 10 inches thick. The subsoil is about 43 inches thick. The upper part is dark yellowish brown, firm clay loam that has a thin stratum of loam, and the lower part is dark brown, firm gravelly clay loam that has a thin stratum of gravelly loam. The underlying material to a depth of about 70 inches is gray and brown, loose gravelly loamy coarse sand. In some areas the lower part of the subsoil has a few gray mottles.

Included with this soil in mapping are small areas of Glynwood, Sleeth, and Westland soils. Glynwood soils are moderately well drained and are near breaks to the uplands. They have more clay throughout than the Ockley soil and are underlain by glacial till. The somewhat poorly drained Sleeth soils and the very poorly drained Westland soils are in depressions and along drainageways. Also included are areas where the underlying material is a poor source of sand and gravel and a few small pits from which gravel has been removed for local use. Inclusions make up about 20 percent of most areas.

Permeability is moderate in the solum of the Ockley soil and very rapid in the underlying material. Surface runoff is slow. The root zone is deep. The available water capacity is moderate. Tilth is good. The surface layer has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting and to irrigation. Droughtiness is the main management concern. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature early in the growing season than to those that mature later. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration and conserve soil moisture. Returning crop residue to the soil and adding other organic material conserve soil moisture, help to maintain good tilth, and improve fertility. Plant nutrients are leached at a faster rate in this soil than in most of the other soils in the county. Consequently, crops generally respond better to smaller, more frequent or more timely applications of fertilizer and lime than to one large application.

Pasture rotation, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress can help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and septic tank absorption fields. A moderate shrink-swell potential is the main limitation on sites for buildings. Properly grading the sites helps to keep surface water away from foundations. Strengthening foundation walls and concrete slabs and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. Sloughing is a hazard in excavations. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by low soil strength and by shrinking and swelling.

This soil is a probable source of sand and gravel.

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

OcB—Ockley loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil generally is on low knolls and ridges on outwash plains and stream terraces. In a few areas, however, it is on moraines. Most areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable loam about 9 inches thick. The subsoil is about 39 inches thick. The upper part is dark yellowish brown and brown, firm clay loam, and the lower part is dark brown, friable gravelly clay loam and gravelly sandy clay loam. The underlying material to a depth of about 60 inches is brown, loose, stratified gravelly and very gravelly coarse sand. In a few areas the underlying material has thin strata of loam and silt loam. In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of Fox, Glynwood, and Kendallville soils. Fox soils have a subsoil that is thinner than that of the Ockley soil. They are in landscape positions similar to those of the Ockley soil. Glynwood soils are moderately well drained and are near slope breaks to the uplands. They have more clay throughout than the Ockley soil and are underlain by glacial till. Kendallville soils also are underlain by glacial till. They are on low knolls and side slopes. Also included, along streams, are a few small areas of soils that have slopes of more than 6 percent and have a surface layer of clay loam. Included soils make up about 10 percent of most areas.

Permeability is moderate in the solum of the Ockley soil and very rapid in the underlying material. Surface runoff is medium. The root zone is deep. The available water capacity is moderate. Tilth is good. The surface layer has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting and to irrigation. Erosion and droughtiness are the main management concerns. The soil dries early in spring, and plants often exhibit moisture stress late in summer. Because of the droughtiness, the soil is better suited to the crops that mature early in the growing season than to the those that mature later. Conservation tillage systems that leave crop residue on the surface, including no-till planting, increase the rate of water infiltration, conserve soil moisture, and reduce the hazard of erosion. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system also helps to control erosion. Returning crop residue to the soil and adding other organic material conserve soil moisture, help to maintain good tilth, and improve fertility. Plant nutrients are leached at a faster rate in this soil than in most of the other soils in the county. Consequently, crops generally respond better to smaller, more frequent or more timely applications of fertilizer and lime than to one large application.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and septic tank absorption fields. A moderate shrink-swell potential is the main limitation on sites for buildings. Properly grading the sites helps to keep surface water away from foundations. Strengthening foundation walls and concrete slabs and backfilling with material that has a low shrink-swell potential help to prevent the structural damage caused by shrinking and swelling. 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 foundations. Sloughing is a hazard in excavations. Strengthening or replacing the base material helps to prevent the damage to local roads and streets caused by low soil strength and by shrinking and swelling.

If used as sites for septic tank absorption fields, areas of the included Fox soils are susceptible to the seepage of effluent. In these areas the effluent drains freely and can contaminate underground water supplies.

The Ockley soil is a probable source of sand and gravel.

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

Ot—Olentangy silt loam. This deep, level, very poorly drained soil is near the center of small depressions on till plains and lake plains. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 2 to 10 acres in size and are roughly oval or circular.

Typically, the surface layer is very dark grayish brown, firm silt loam about 11 inches thick. The subsurface layer is black, mottled, friable mucky silt loam about 10 inches thick. The next layer is dark grayish brown, friable silt loam (coprogenous earth) about 9 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, very friable silt loam that has small white snail shells. In some areas the surface layer is overwash of silty clay loam.

Included with this soil in mapping are a few small areas of Carlisle, Milford, and Pewamo soils. Carlisle soils have more than 51 inches of muck. They are in the lowest landscape positions. The mineral Milford and Pewamo soils occur as thin strips along the margin of the mapped areas. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Olentangy soil is near or above the surface during extended wet periods. Permeability is moderate in the subsoil and slow in the underlying material. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is very high. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer has a high content of organic matter.

Most areas are used as cropland. Some areas are used as pasture. A few areas are undrained and support native plants.

This soil is moderately well suited to corn, soybeans, small grain, hay and pasture, and some specialty crops. A drainage system is needed. 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. Establishing or maintaining outlets for subsurface drains is difficult in many areas. Ditchbanks are unstable. Crops grown on this soil are subject to early season frost damage because of the low position on the landscape.

This soil is moderately well suited to trees. The wetness is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness can reduce 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.

A few undrained areas of this soil are well suited to habitat for wetland wildlife. In these areas the soil supports some water-tolerant trees, cattails, reeds, and sedges.

This soil generally is unsuited to buildings and septic tank absorption fields. The ponding, low soil strength, the potential for frost action, and the slow permeability in the underlying material are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, ponding, and frost action.

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

Pa—Patton silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats and in slightly depressional areas on lake plains. Slope is 0 to 2 percent. Most areas range from 50 to 400 acres in size and are irregularly shaped.

Typically, the surface layer is black, friable silty clay loam about 11 inches thick. The subsoil is gray, mottled, firm and friable silty clay loam about 26 inches thick. The underlying material to a depth of about 60 inches is grayish brown and dark grayish brown, mottled, friable silt loam and firm silty clay loam lacustrine sediment. In a few areas the surface layer is thinner. In a few places the subsoil has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount and Del Rey soils on low knolls and ridges. Also included, in small depressions, are areas of soils that have a mucky surface layer. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Patton soil is near or above the surface during extended wet periods. Permeability is moderately slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth is fair. The surface layer has a high content of organic matter.

Nearly all areas are used as cropland. Only a few areas are used for pasture or trees.

This soil is especially well suited to corn, soybeans, small grain, and hay and pasture if a drainage system is installed. The seasonal wetness and surface compaction are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in spring. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. In some areas drainage outlets are ineffective during periods of flooding in the surrounding ditches and streams. A method of tillage that leaves a rough or ridged surface partly covered with crop residue hastens drying. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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. The trees can be logged during the drier parts of the year or when the soil is frozen.

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 and septic tank absorption fields helps to keep surface water away from the foundations and the 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 foundations to allow for good drainage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, ponding, and frost action.

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 5W.

Pm—Pewamo silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats, in closed depressions, and along intermittent drainageways on till plains and lake plains. Slope is 0 to 2 percent. Most areas range from 5 to more than 500 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, firm silty clay loam about 11 inches thick. The subsoil is about 22 inches of dark gray and gray, mottled, firm silty clay loam and silty clay. The underlying material to a depth of about 60 inches is gray, mottled, calcareous, firm clay loam glacial till. In many areas the surface layer has less organic matter and is thinner or lighter in color. In a few places the glacial till is at a depth of more than 70 inches.

Included with this soil in mapping are small areas of Blount, Milford, and Saranac soils. The somewhat poorly drained Blount soils are on slight rises. Milford soils formed in lacustrine sediment in depressions and along drainageways. The occasionally flooded Saranac soils are along drainageways. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Pewamo soil is near or above the surface during extended wet periods. Permeability is moderately slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth is fair. The surface layer has a high content of organic matter.

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

This soil is especially well suited to corn, soybeans, small grain, and hay and pasture if a drainage system is installed. The seasonal wetness and surface compaction are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in spring. Grassed berms along open ditches help to prevent the gullying caused by concentrated flow from the surrounding areas (fig. 9). Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. In some areas drainage outlets are ineffective during periods of

Figure 9.—Grassed berms along open ditches in an area of Pewamo silty clay loam.

flooding in the surrounding ditches and streams. A method of tillage that leaves a rough or ridged surface partly covered with crop residue hastens drying. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Grassed waterways can help to slow and direct the movement of water in some areas.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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 and septic tank absorption fields helps to keep surface water away from the foundations and the 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 foundations to allow for good drainage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength, ponding, and frost action.

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 5W.

Po—Pewamo Variant muck. This deep, level, very poorly drained soil is on broad flats along the margin of lake plains. Slope is 0 to 1 percent. Most areas range from 25 to 250 acres in size and are long and irregularly shaped.

Typically, the surface layer is black, friable muck about 8 inches thick. The subsoil is dark gray, mottled, calcareous, firm clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown, mottled, calcareous, very firm clay loam glacial till. In some areas the upper part of the subsoil is silty clay loam or silt loam. In a few areas the surface layer is mucky silt loam.

Included with this soil in mapping are small areas of McGuffey, Pewamo, and Roundhead soils. McGuffey and Roundhead soils are in landscape positions similar to those of the Pewamo Variant soil. McGuffey soils formed in clayey lacustrine sediment, and Roundhead soils formed in silty lacustrine sediment. Pewamo soils are on very slight rises adjacent to the uplands. Also included are a few areas where the upper part of the subsoil has thin strata of sandy loam, sandy clay loam, loam, or silty clay. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Pewamo Variant soil is near or above the surface during extended wet periods. Permeability is moderately slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is moderate. The potential for frost action is high. Tilth is good. The surface layer has a very high content of organic matter.

Nearly all areas have been drained and are used as cropland. This soil is well suited to corn, soybeans, small grain, hay and pasture, and some specialty crops. The ponding and the hazard of soil blowing are the main management concerns. A drainage system is needed. 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. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. Deepening the outlet ditches can improve the effectiveness of subsurface drainage systems. In some areas outlets are ineffective during periods of flooding in the surrounding ditches and streams. Pumping stations can reduce the amount of time that ponded water stands in fields. Subsidence and shrinkage occur as a result of oxidation in the organic material after the soil is drained. During dry periods the soil is subject to soil blowing. Planting cover crops, returning crop residue to the soil, irrigating, and establishing windbreaks can reduce the hazard of soil blowing. Crops grown on this soil are subject to early season frost damage because of the low position on the landscape.

In the larger areas of this soil, windbreaks are needed to reduce the hazard of soil blowing. Selecting the species of trees and shrubs that are tolerant of wetness can reduce the seedling mortality rate. Fast-growing species that have desirable growth characteristics should be selected for planting. The trees and shrubs should be planted at right angles to the prevailing wind.

This soil generally is unsuited to buildings and septic tank absorption fields. The ponding and the slow or moderately slow permeability are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, low soil strength, and frost action.

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

Ps—Pits, gravel. This map unit consists of open excavations from which gravel and sand have been removed. It typically is in areas of hummocky relief and on stream terraces associated with Belmore, Fox, Ockley, Martinsville, and Morley soils. Slopes are very irregular because of spoil piles, overburden, and unmined banks. Clay loam glacial till is at the bottom of some of the pits.

The pits vary considerably in size and depth. Most are 5 to 50 acres in size. Pits smaller than 1 acre are identified by a spot symbol on the soil maps. Many of the smaller pits have not been recently used. Some areas are barren, and others have filled with water and are small ponds. Most areas, however, are being slowly revegetated by a natural plant succession of weeds, grasses, shrubs, and drought-tolerant tree species.

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

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

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

No land capability classification or woodland ordination symbol is assigned.

Pt—Pits, quarry. This map unit is in areas where dolomitic limestone has been quarried. It generally is on uplands associated with Milton, Millsdale, Blount, and Morley soils. Actively mined quarries are continually being enlarged. Most quarries have a high wall on one or more sides (fig. 10). Most areas range from 5 to 200 acres in size and are irregularly shaped.

Included with this unit in mapping are small stock piles underlain by overburden, loose and processed stone, and processing plants.

Prior to quarrying, the overburden, including the original soil material, is commonly removed and stockpiled or is used as earthfill. The material below the original soil generally is calcareous. It is very low in content of organic matter and is highly susceptible to erosion. The available water capacity varies.

Establishing a plant cover in areas that are no longer mined reduces the hazards of erosion and siltation. Blanketing these areas with topsoil aids in the establishment and maintenance of a plant cover. The plant species that are tolerant of a fairly low available water capacity and of unfavorable soil properties should be selected for planting.

In some areas the quarries contain water and can be developed for use as wildlife habitat or for recreation. They generally are unsuitable as sites for sanitary landfills because the effluent can pollute underground water supplies.

No land capability classification or woodland ordination symbol is assigned.

Ro—Roundhead muck. This deep, level, very poorly drained soil is on broad flats on lake plains and in marshes. Slope is less than 1 percent. Most areas range from 75 to more than 500 acres in size and are irregularly shaped.

Typically, the surface layer is black, very friable muck about 10 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown and grayish brown, mottled, calcareous, friable silt loam, and the lower part is gray, mottled, calcareous, firm silty clay loam. The underlying material to a depth of about 60 inches is gray, mottled, calcareous, firm silt loam lacustrine sediment that has thin strata of silty clay loam. In some areas the organic layer is thicker. In a few places the upper part of the subsoil has a thin layer of sedimentary peat.

Included with this soil in mapping are small areas of McGuffey, Patton, and Pewamo Variant soils. McGuffey soils have more clay in the subsoil and underlying material than the Roundhead soil. They are in landscape positions similar to those of the Roundhead soil. The mineral Patton soils are on very slight rises. Pewamo Variant soils formed in a thin layer of organic material and in the underlying glacial till. They are along the margin of the mapped areas, adjacent to uplands. Also included, along the Scioto River, are a few areas that are subject to flooding. Included soils make up about 10 percent of most areas.

The seasonal high water table in the Roundhead soil is near or above the surface during extended wet periods. Permeability is slow or moderately slow. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is very high. The potential for frost action is high. Tilth is good. The surface layer has a very high content of organic matter.

Nearly all areas have been drained and are used as cropland. This soil is well suited to corn, soybeans, small grain, and hay and pasture and is especially well suited to some specialty crops. The ponding and the hazard of soil blowing are the main management concerns. A drainage system is needed. Surface and subsurface drains help to lower the seasonal high water table, improve aeration, and permit earlier tillage and planting in spring. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. Deepening the outlet ditches can improve the effectiveness of subsurface drainage systems. In some areas outlets are ineffective during periods of flooding in the surrounding rivers and ditches. Pumping stations can reduce the amount of time that ponded water stands in fields. Subsidence and shrinkage occur as a result of oxidation

Figure 10.—A high wall in an area of Pits, quarry.

in the organic material after the soil is drained. During dry periods the soil is subject to soil blowing. Planting cover crops, returning crop residue to the soil, irrigating, and establishing windbreaks can reduce the hazard of soil blowing. Fire is a hazard during dry periods. In some areas, the surface layer is calcareous and the soil is deficient in manganese. Applying excessive amounts of lime can worsen this deficiency. Crops grown on this soil are subject to early season frost damage because of the low position on the landscape.

In the larger areas of this soil, windbreaks are needed to control soil blowing. Selecting the species of trees and shrubs that are tolerant of wetness can reduce the seedling mortality rate. Fast-growing species that have desirable growth characteristics provide adequate protection. The trees and shrubs should be planted at right angles to the prevailing wind.

This soil generally is unsuited to buildings and septic tank absorption fields. The ponding and the moderately slow or slow permeability in the lacustrine sediment are the main limitations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding, frost action, and low soil strength.

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

Sa—Saranac silty clay loam, occasionally flooded. This deep, nearly level, very poorly drained soil is on flood plains. It commonly makes up the entire flood plain along streams that have low gradients. The soil is occasionally flooded during the growing season. Slope is 0 to 2 percent. Most areas range from 10 to 100 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, firm silty clay loam about 34 inches thick. The underlying material to a depth of about 60 inches is olive brown, mottled, firm silty clay loam that has a thin layer of silt loam. In some places the surface layer is lighter in color. In other places the subsoil has more sand. In a few areas the soil is only rarely flooded.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils on the higher parts of the flood plains. These soils make up about 5 percent of most areas.

The seasonal high water table in the Saranac soil is at or near the surface during extended wet periods. Permeability is moderately slow. Surface runoff is very slow. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth is fair. The surface layer has a high content of organic matter.

Most areas are used as cropland. A few areas are wooded or are left as idle land.

This soil is moderately well suited to corn, soybeans, and hay and pasture. Winter grain crops commonly are not grown because of the hazard of flooding. The occasional flooding and the seasonal wetness are the main management concerns. A drainage system is needed. 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 many areas establishing adequate drainage outlets is difficult. The outlets are ineffective during periods of flooding in the surrounding rivers and streams. Protective levees can reduce the frequency of flooding. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Winter cover crops protect the soil from scouring by floodwater. Stabilizing streambanks is difficult in many areas. Clearing the channel of debris, grading the streambanks, and adding riprap or suitable plant material on the streambanks help to prevent excessive erosion.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and 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 generally is unsuited to buildings and septic tank absorption fields. The occasional flooding, the moderately slow permeability, and the seasonal wetness are the major limitations. Roads, bridges, farm buildings, and other structures require special design to prevent the damage caused by floodwater. Fill material that elevates structures above the known high water level helps to prevent this damage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by flooding, seasonal wetness, and low soil strength.

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

ShB—Shinrock silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on low knolls and side slopes on lake plains. Most areas range from 5 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 27 inches of yellowish brown, olive brown, and light olive brown, mottled, firm and very firm silty clay loam. It has strata of silt loam in the lower part. It is mottled below a depth of about 10 inches. The underlying material to a depth of about 60 inches is light olive brown, mottled, very firm silty clay loam. In some areas, the subsoil has less clay and the soil is well drained.

Included with this soil in mapping are small areas of Del Rey, Fulton, and Milford soils. The somewhat poorly drained Del Rey and Fulton soils are at the base of the slopes, in depressions, and along drainageways. The very poorly drained Milford soils are at the base of the slopes and along drainageways. Also included are small areas of soils that are very firm silty clay throughout.

Included soils make up about 10 percent of most areas.

The seasonal high water table in the Shinrock soil is perched in the lower part of the subsoil during extended wet periods. Permeability is moderately slow. Surface runoff is medium. The root zone is deep. The available water capacity is moderate. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer tends to crust after hard rains. It has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is well suited to no-till planting. Erosion is the main management concern. Conservation tillage systems that leave crop residue on the surface, including no-till planting, help to control erosion and increase the rate of water infiltration. Grassed waterways are effective in slowing concentrated runoff and in controlling erosion. Including close-growing crops in the cropping system 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 minimize surface compaction. Random subsurface drains are needed in the wetter included soils.

Pasture rotation, proper stocking rates, and deferred grazing during extended periods of wetness or moisture stress can help to keep pastures in good condition.

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. A high content of clay in the subsoil is the main management concern. Planting techniques that spread the roots of seedlings and improve the soil-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. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is well suited to buildings and moderately well suited to septic tank absorption fields. The seasonal wetness, the moderately slow permeability, and a moderate shrink-swell potential are the main limitations. 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 foundations. 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. 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. Sloughing is a hazard in excavations. Installing a drainage system and strengthening or replacing the base material can help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

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 IIe. The woodland ordination symbol is 4C.

SkA—Sleeth silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is in slightly elevated areas on stream terraces and outwash plains. Most areas range from 5 to 25 acres in size and are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown and brown, mottled, friable and firm silty clay loam and clay loam having a thin stratum of sandy clay loam, and the lower part is dark grayish brown, mottled, friable clay loam and sandy clay loam. The underlying material to a depth of about 60 inches is grayish brown and dark gray, loose gravelly clay that has thin strata of sand. In places, the surface layer and subsoil are thinner and the underlying material is gravelly sandy loam. In a few areas the subsoil has more clay. In some areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas of Del Rey, Ockley, and Westland soils. Del Rey soils have more clay in the subsoil than the Sleeth soil and have underlying material of silt loam and silty clay loam. They are along the edge of the mapped areas, adjacent to lake plains. The well drained Ockley soils are on low knolls. The very poorly drained Westland soils are in depressions and along drainageways. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Sleeth soil is in the upper part of the subsoil during extended wet periods. Permeability is moderate in the subsoil and very rapid in the underlying material. Surface runoff is slow. The root zone is deep. The available water capacity is high. The potential for frost action also is high. Tilth generally is good unless the soil is tilled when wet. The surface layer has a moderate content of organic matter.

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

This soil is well suited to corn, soybeans, small grain, and hay and pasture. It is suited to no-till planting if it is drained. The 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. Conservation tillage systems that leave crop residue on the surface, including no-till planting, reduce the hazard of sheet erosion and increase 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 minimize surface compaction.

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

This soil is well suited to trees. Most woodlots are mixed stands of native hardwoods. Plant competition can be controlled by removing the less desirable trees and shrubs.

This soil is moderately well suited to buildings and poorly suited to septic tank absorption fields. The seasonal wetness is the main limitation. Properly grading building sites helps to keep surface water away from foundations. Drains at the base of footings and coatings on the exterior of basement walls help to prevent wetness in basements. Sloughing is a hazard in excavations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by low soil strength and by frost action.

Perimeter drains around septic tank absorption fields 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 can reduce the wetness.

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

So—Sloan silt loam, frequently flooded. This deep, nearly level, very poorly drained soil is on flood plains. It commonly makes up the entire flood plain along streams that have low gradients. The soil is frequently flooded during the growing season. Slope is 0 to 2 percent. Most areas range from 10 to 100 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 34 inches thick. The upper part is dark gray, mottled, friable silt loam and firm clay loam, and the lower part is gray, mottled, firm clay loam and silty clay loam. The underlying material to a depth of about 60 inches is gray, mottled, firm clay loam. In places the subsoil has more clay. In a few areas the soil is occasionally flooded.

Included with this soil in mapping are small areas of the somewhat poorly drained Newark soils on the higher parts of the flood plains. Also included, along Hog Creek, are small areas of soils that have limestone bedrock at a depth of 40 to 60 inches. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Sloan soil is at or near the surface during extended wet periods. Permeability is moderate or moderately slow. Surface runoff is very slow. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth generally is good unless the soil is tilled when wet. The surface layer has a moderate content of organic matter.

Most areas are used as cropland. A few areas are wooded or are left as idle land.

This soil is moderately well suited to corn, soybeans, and hay and pasture. Winter grain crops commonly are not grown because of the hazard of flooding. The frequent flooding and the seasonal wetness are the main management concerns. A drainage system is needed. 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 many areas establishing adequate drainage outlets is difficult. The outlets are ineffective during periods of flooding in the surrounding rivers and streams. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Winter cover crops and crop residue help to protect the soil from scouring by floodwater. Stabilizing eroding streambanks is difficult in many areas. Clearing the channel of debris, grading streambanks, and adding riprap or suitable plant material on the streambanks help to prevent excessive erosion.

The pasture plants selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The frequent flooding and the seasonal wetness are the main management concerns. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and 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 generally is unsuited to buildings and septic tank absorption fields. The frequent flooding, the moderately slow permeability, and the seasonal wetness are the major limitations. Roads, bridges, farm buildings, and other structures require special design to prevent the damage caused by floodwater. Fill material that elevates structures above the known high water level helps to prevent this damage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by flooding, seasonal wetness, and low soil strength.

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

Wa—Wallkill silt loam, frequently flooded. This deep, nearly level, very poorly drained soil is on flood plains and in a few scattered depressions on till plains and outwash plains. It is frequently flooded during the growing season. Slope is 0 to 2 percent. Most areas range from 5 to more than 200 acres in size and are long and narrow or oval.

Typically, the surface layer is very dark gray, friable silt loam about 11 inches thick. The subsoil is very dark gray and very dark grayish brown, mottled, friable silt loam about 14 inches thick. The underlying material to a depth of about 60 inches is black and dark reddish brown, friable muck. In a few areas the lower part of the underlying material is silt loam lacustrine material.

Included with this soil in mapping are small areas of Carlisle soils. These soils are farther away from stream channels than the Wallkill soil. They make up about 10 percent of most areas.

The seasonal high water table in the Wallkill soil is near or above the surface during extended wet periods. Permeability is moderate in the mineral material and moderately rapid or rapid in the underlying organic material. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is very high. The potential for frost action is high. Tilth generally is good unless the soil is tilled when wet. The surface layer has a high content of organic matter.

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

This soil is moderately well suited to corn, soybeans, and hay and pasture. Winter grain crops generally are not grown because of the hazard of flooding. The frequent flooding and the seasonal wetness are the main management concerns. A drainage system is needed. 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 establishing adequate drainage outlets is difficult. The outlets are ineffective during periods of flooding in the surrounding rivers and streams. Subsidence or shrinkage occurs as a result of oxidation in the organic material after the soil is drained. Controlled drainage in areas where the water table can be raised or lowered minimizes shrinkage. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction. Winter cover crops protect the soil from scouring by floodwater. Stabilizing eroding streambanks is difficult is many areas. Clearing the channel of debris, grading streambanks, and adding riprap or suitable plant material on the streambanks help to prevent excessive erosion.

The pasture species selected for seeding 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 generally is unsuited to trees. The frequent flooding and the seasonal wetness are the main management concerns. The trees can be logged when the soil is frozen or during the drier parts of the year. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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.

A few undrained areas of this soil are well suited to habitat for wetland wildlife. In these areas the soil supports water-tolerant trees, cattails, reeds, and sedges.

This soil generally is unsuited to buildings and septic tank absorption fields. The main management concerns are the frequent flooding, the seasonal wetness, low soil strength, and a poor filtering capacity. If the soil is used as a site for septic tank absorption fields, the poor filtering capacity can result in the pollution of ground water. Roads, bridges, farm buildings, and other structures require special design to prevent the damage caused by flooding. Fill material that elevates structures above the known high water level helps to prevent this damage. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by flooding, seasonal wetness, and frost action.

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

We—Westland clay loam. This deep, nearly level, very poorly drained soil is on flats, in shallow depressions, and along drainageways on outwash plains and stream terraces. It receives runoff from the higher adjacent soils and is subject to ponding. Slope is 0 to 2 percent. Most areas range from 10 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray, friable clay loam about 12 inches thick. The subsoil is about 35 inches thick. The upper part is dark gray and dark grayish brown, mottled, firm clay loam, and the lower part is dark gray, mottled, friable loam. The underlying material to a depth of about 80 inches is brown, loose very gravelly loamy coarse sand glacial outwash. It has thin strata of loam and loamy sand in the upper part. In a few areas the subsoil has more clay. In some areas the surface layer is silty clay loam. In a few places the solum is thinner.

Included with this soil in mapping are small areas of Fox, Linwood, Pewamo, and Sleeth soils. The well drained Fox soils are on small rises. Linwood soils have muck in the upper part. They are in shallow depressions. Pewamo soils have more clay throughout than the Westland soil. They are along the periphery of the mapped areas, adjacent to the uplands. The somewhat poorly drained Sleeth soils are on slight rises. Also included, in shallow depressions, are small areas of soils that have a mucky surface layer. Included soils make up about 15 percent of most areas.

The seasonal high water table in the Westland soil is near or above the surface during extended wet periods. Permeability is moderate in the subsoil and very rapid in the underlying material. Surface runoff is very slow or ponded. The root zone is deep in drained areas. The available water capacity is high. The potential for frost action also is high. Tilth is fair. The surface layer has a high content of organic matter.

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

This soil is especially well suited to corn, soybeans, small grain, and hay and pasture if a drainage system is installed. The seasonal wetness and surface compaction are the main management concerns. A combination of surface and subsurface drains helps to lower the seasonal high water table, improves aeration, and permits earlier tillage and planting in spring. In some areas drainage outlets are ineffective during periods of flooding in the surrounding ditches and streams. Grade-changing structures help to control erosion in areas where the water from surface drains enters the deeper outlet ditches. Grassed waterways can help to slow and direct the movement of water in some areas. A method of tillage that leaves a rough or ridged surface partly covered with crop residue hastens drying. Applying a system of conservation tillage and limiting fieldwork when the soil is wet minimize surface compaction.

The pasture species selected for seeding 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 moderately well suited to trees. Most woodlots are mixed stands of native hardwoods. The wetness is the main management concern. Planting seedlings that have been transplanted once and are tolerant of seasonal wetness 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. The trees can be logged during the drier parts of the year or when the soil is frozen.

This soil is poorly suited to buildings and septic tank absorption fields. The ponding is the main hazard. Properly grading building sites and septic tank absorption fields helps to keep surface water away from the foundations and the 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 foundations to allow for good drainage. Sloughing is a hazard in excavations. Installing a drainage system and strengthening or replacing the base material help to prevent the damage to local roads and streets caused by ponding and frost action.

Perimeter drains around septic tank absorption fields help to lower the seasonal high water table and facilitate the absorption of effluent during wet periods. Underground water supplies can be contaminated by seepage from sewage lagoons, sanitary landfills, or other sanitary facilities requiring excavation of the soil.

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

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 284,000 acres in the survey area, or 95 percent of the total acreage, meets the soil requirements for prime farmland. Most of this acreage 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. A drainage system is needed on about 90 percent of the acreage of the prime farmland in the county. Also, flood control and a drainage system are needed on about 611 acres of a very poorly drained soil that is frequently flooded during the growing season. 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 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 the survey area are assigned to various interpretative 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

Edison L. Klingler, county extension agent, helped prepare this section.

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

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under 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.

More than 255,000 acres in the county, or about 85 percent of the total acreage, was used as cropland or pasture in 1984. Of this total, nearly 12,000 acres was used as pasture and nearly 243,000 acres was used as cropland. About 184,200 acres was used mainly for corn or soybeans, 36,800 acres for wheat and oats, and 7,900 acres for hay *(5)*.

The soils and climate in the survey area are suited to most of the crops commonly grown in the area and to some that are not so common, such as barley, grain sorghum, popcorn, and sunflowers. Corn and soybeans are the main row crops. Grain sorghum, sugar beets, sunflowers, navy beans, and similar crops can be grown if economic conditions are favorable. Wheat and oats are the most common close-growing crops. Alfalfa and grass-legume hay also are grown. The soils and climate are suited to barley, buckwheat, and flax. Grass seed can be produced from bromegrass, fescue, timothy, and bluegrass.

The specialty crops grown commercially in the survey area include apples, popcorn, potatoes, carrots, strawberries, and sweet corn. The acreage of such crops could be increased if economic conditions were favorable. Deep, well drained, loamy soils that warm early in spring are well suited to many vegetables, small fruits, nursery plants, and orchard crops. Examples are

Fox, Kendallville, Martinsville, and Ockley soils on terraces and outwash plains and Nolin soils on flood plains. In places these soils are in low areas where air drainage is poor and frost occurs earlier and more frequently. The soils in these areas generally are poorly suited to early maturing small fruit and orchard crops.

Very friable mucky soils, such as Roundhead and McGuffey soils, are well suited to root crops, such as table beets, carrots, and potatoes. The county has about 12,000 acres of mucky soils that could be used for other late-season or early maturing crops or for frost-resistant vegetable crops.

The latest information about growing specialty crops can be obtained from local offices of the Ohio Cooperative Extension Service and the Soil Conservation Service.

The potential for increased crop production in Hardin County is good. Both the acreage farmed and the yields per acre can be increased. About 30,000 acres of idle land, woodland, and unimproved pasture could be used as productive cropland. The cost of converting this acreage to cropland and the impact of such a conversion on the environment, however, should be considered *(11)*. Food production also can be increased by applying the latest crop production technology to the existing cropland in the county.

Very little of the cropland and pasture in Hardin County has been used for urban development. In 1984, an estimated 11,655 acres was used as urban land *(11)*. The extent of this land has been increasing at a rate of about 60 acres per year.

The major concerns in managing the soils in the county for crops and pasture are wetness, water erosion, soil blowing, the level of fertility, and deterioration of tilth.

Wetness is the major management concern in Hardin County. It is a limitation on nearly 87 percent of the acreage. Subsurface and surface drains are used to remove excess water and thus allow tilling and planting early in spring. Short-season or early maturing crop varieties can be harvested earlier. Subsurface drains lower the seasonal high water table and thus increase the depth to which plant roots can penetrate.

Some of the soils commonly have a seasonal high water table above or near the surface. Natural drainage outlets are not available because of the position of these soils on the landscape. Unless a subsurface drainage system is installed, these soils are usually too wet for most of the crops commonly grown in the county. The very poorly drained Carlisle, Colwood, Latty, Linwood, McGuffey, Milford, Millsdale, Montgomery, Olentangy, Patton, Pewamo, Pewamo Variant, Roundhead, Wallkill, and Westland soils have a seasonal high water table above the surface. These soils make up about 108,000 acres in the county, or more than 35 percent of the total acreage.

The somewhat poorly drained soils in the county have a water table in the upper part of the subsoil in winter and spring. A subsurface drainage system is needed if these soils are used for most of the crops commonly grown in the county. Unless the soils are drained, the crops grow slowly and yields generally are lower. Planting and harvesting are usually delayed by the wetness. Blount, Del Rey, Fulton, Haskins, Kibbie, Newark, and Sleeth soils are somewhat poorly drained. These soils make up about 152,000 acres in the county, or more than 50 percent of the total acreage.

Commonly included in areas of the moderately well drained Glynwood and Shinrock soils are wetter soils in seepy areas and swales and along drainageways, especially where slopes are 2 to 6 percent. Surface and subsurface drains are effective in these wetter areas.

The design of both surface and subsurface drainage systems varies with the type of soil and the availability of adequate outlets. A combination of surface and subsurface drains is needed in most areas of the very poorly drained and somewhat poorly drained soils that are intensively row cropped. The drains should be more closely spaced in slowly permeable or very slowly soils than in the more permeable soils. Subsurface drainage is slow or very slow in Del Rey, Fulton, Latty, McGuffey, and Montgomery soils. Establishing or maintaining open ditches that provide outlets for subsurface drainage systems is costly in areas of the very poorly drained soils.

Special drainage systems are needed to control the depth and period of drainage in organic soils, such as Carlisle soils. These soils oxidize and subside when their pore spaces are filled with air. Oxidation and subsidence can be minimized by keeping the water table at the level required by the crops during the growing season and then raising it to the surface during the rest of the year.

Maintaining a drainage system is more economical than replacing the system. Seeding ditchbanks and berms helps to prevent excessive streambank erosion and the slumping of banks. Removing brush reduces the likelihood that floodwater will rise above the level of outlets for subsurface drains. Animal guards keep animals from damaging subsurface drains and blocking the flow of water. Replacing broken drains keeps silt from accumulating on the bottom of the drains and blocking drainage.

Further information about the design of drainage systems for each soil in the survey area is available at the office of the Hardin Soil and Water Conservation District.

Water erosion is a major management concern on about 40 percent of the acreage in Hardin County. It is a hazard where slopes are more than 2 percent. The Blount, Del Rey, Fulton, Haskins, Kibbie, and Sleeth soils that have slopes of more than 2 percent are subject to erosion.

Erosion reduces the productivity of soils and pollutes the water in streams and lakes. It is especially damaging on soils that have a clayey subsoil, such as Glynwood and Morley soils. As the surface layer is removed, part of the clayey subsoil is incorporated into the plow layer. Tilth is poorer because of the higher content of clay in the altered surface layer. The seedbed also is poorer. More energy is needed when the soils are tilled, and more fertilizer is needed to replace lost plant nutrients. Erosion also damages soils that are moderately deep over bedrock, such as Milton soils, because it further reduces the thickness of the root zone. Erosion reduces the productivity of soils that tend to be droughty, such as Belmore and Fox soils. The surface layer stores the largest amount of water in these soils. If this layer is eroded, the available water capacity of the soils is reduced.

Erosion degrades water quality by increasing the amount of sediment in streams and lakes. Sediment is the chief pollutant of streams in Hardin County. It indirectly degrades water quality because of the organic matter, plant nutrients, herbicides, and insecticides it carries from the eroding fields. Control of erosion minimizes the pollution of streams and lakes by sediment and improves the quality of water available for municipal and recreational uses and for fish and wildlife.

Measures that control erosion provide a protective cover, help to control runoff, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods helps to control erosion. Including forage crops of grasses and legumes in the cropping sequence reduces the risk of erosion, provides nitrogen, and improves tilth.

The sloping or moderately steep Belmore, Fox, Glynwood, and Morley soils have short, irregular slopes. Erosion is a severe hazard if these soils are farmed by conventional methods. Minimum tillage and no-till farming systems, which leave crop residue on the surface, increase the rate of water infiltration and reduce the hazards of runoff and erosion. Contour farming and terracing generally are not practical on these soils because of the short, irregular slopes. Belmore, Fox, Kendallville, Martinsville, Morley, Milton, Nolin, Ockley, and Shinrock soils and some areas of Glynwood soils are well suited to no-till farming. Eroded areas of Glynwood soils are suited to no-till farming. Blount, Del Rey, Eel, Haskins, Kibbie, Newark, and Sleeth soils also are suited if they are drained.

Grassed waterways are natural or constructed outlets protected by a cover of grasses. Natural drainageways are the best sites for these waterways because a minimum of shaping commonly is needed to produce a good channel in the drainageways. The waterways should be wide and flat, so that they can be easily crossed by farm machinery.

Information about the design of erosion-control measures for each kind of soil is available at the office of the Hardin Soil and Water Conservation District.

Soil blowing is a hazard on soils that have a surface layer of muck, such as Carlisle, Linwood, McGuffey, Pewamo Variant, and Roundhead soils. These soils are subject to soil blowing if winds are strong and the soils are level and dry and are not protected by vegetation or mulch. Maintaining a cover of plants or mulch or keeping the surface ridged or rough through proper tillage reduces the hazard of soil blowing. Field windbreaks of suitable shrubs and trees, such as imperial Carolina poplar, also are effective in reducing the risk of soil blowing.

In many areas on uplands, soils that have a light colored surface layer are naturally lower in fertility than other soils. These light colored soils are naturally more acid than the darker soils and have a moderate, moderately low, or low content of organic matter in the surface layer. The more acid subsoil limits the availability of plant nutrients. The soils on flood plains, such as Eel, Newark, Nolin, Saranac, and Sloan soils, are naturally higher in content of plant nutrients than most of the soils on uplands. They have a moderate or high content of organic matter in the surface layer. The surface layer of Colwood, Milford, Millsdale, Montgomery, Patton, Pewamo, and Westland soils, which are on flats and in depressions and drainageways, is very dark gray or black and has a moderate or high content of organic matter. Unless lime has been added, the soils that have a very high content of organic matter in the surface layer, such as Carlisle, Linwood, McGuffey, Pewamo Variant, Roundhead, and Wallkill soils, commonly are naturally acid. Special fertilizer may be needed because of deficiencies of boron and other trace elements.

In areas of the very poorly drained and somewhat poorly drained soils, the effectiveness of applying nitrogen in the fall is reduced by leaching and denitrification. Incorporating fertilizer into the gently sloping and sloping soils reduces the hazard of erosion. Applications of lime are necessary to raise the reaction of the surface layer to the level at which most plant nutrients are readily available. On all of the soils in the county, applications of lime and fertilizer should be based on the results of soil tests and plant analysis. Soil limitations other than fertility should be considered. The Ohio Cooperative Extension Service and private soil labs 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 soils. Soils that have good tilth are friable and porous. They can be worked easily and allow for good seed contact, quick seedling emergence, and strong root growth.

Many of the soils on uplands that are used as cropland have a surface layer of silt loam that is moderate or moderately low in content of organic matter. The surface of these soils generally crusts when it dries after a heavy rainfall. The crust is hard, absorbs water slowly, and fractures very little. It reduces the rate of water infiltration, retards seeding emergence, and increases the runoff rate. Regularly adding crop residue, manure, or other organic material helps to maintain or improve soil structure and minimizes crusting. Minimum or mulch tillage or incorporation of crop residue into the surface layer also minimizes crusting. Allowing part of the residue to be exposed above the surface provides pathways for the movement of air and water.

Moldboard plowing in fall generally is not the best practice on soils that have a surface layer of light colored silt loam because the surface crusts in winter and spring. Many of these soils are nearly as dense and hard after moldboard plowing in fall as they were before they were plowed. Moreover, soils that have slopes of more than 2 percent are more susceptible to erosion if they are moldboard plowed in fall. A rough, irregular surface on which crop residue is partially covered absorbs more water and dries faster than a smoothly tilled surface.

Milford, Millsdale, Montgomery, Patton, Pewamo, and Westland soils have a dark surface layer that has more clay than most of the soils that have a lighter colored surface layer. Poor tilth is a problem because the dark soils tend to stay wet until late in spring. These soils can be tilled only within a narrow range in moisture content. If they are tilled when wet, they tend to be very cloddy and hard when dry. Because of the cloddiness, preparing a good seedbed is difficult. Fall plowing allows winter freezing and drying to break up the clods. Applying a system of mulch tillage and returning crop residue to the soils minimize crusting. Cracks generally form as the soils dry. The cracks increase the rate of water infiltration.

Surface compaction occurs if the soils are tilled or crops are harvested during wet periods or if the soils are subject to heavy traffic or heavy loads. Compaction limits the growth of roots, hinders the movement of water, and results in the formation of plowpans. It can be prevented by tilling the soils at the proper soil moisture content, applying a system of minimum tillage, planting deep-rooted legumes and grasses, and using four-wheel-drive tractors equipped with flotation tires.

Irrigation systems are not used to a great extent in Hardin County. Rainfall usually is not timely or well distributed in the county. During dry periods irrigation can increase yields. Many of the soils in the county can be irrigated if a good supply of irrigation water is available. Belmore, Fox, Kendallville, Martinsville, Milton, and Ockley soils are especially well suited to irrigation.

Permanent pasture makes up about 4 percent of the survey area *(11)*. This low percentage is partly the result of a reduction in the number of livestock and the use of more confined feeding practices. Some of the permanent pasture is in areas of eroded strips and in irregularly shaped areas of frequently flooded soils. A few woodlots also are pastured. They generally provide poor-quality grazing, however, because the forage plants are sparse. The areas of permanent pasture near farmsteads commonly are used as feedlots or access lanes.

Most of the soils in the county are suited to high-quality permanent pasture, although yields vary widely. The sloping and moderately steep Belmore, Fox, Glynwood, and Morley soils commonly are eroded, are low in fertility, and have a limited amount of water available for plants because runoff is rapid. Forage production is low on these soils. Forage species grow well on the gently sloping Blount, Haskins, and Shinrock soils, but these soils are subject to erosion if the plant cover is damaged by overgrazing. Compaction occurs if grazing livestock are allowed to trample the soils during wet periods.

The Eel, Newark, Nolin, Saranac, and Sloan soils on flood plains are potentially well suited to permanent pasture. The occasional or frequent flooding during the growing season on these soils is less damaging to pasture than to grain crops. These alluvial soils are fertile, have a high available water capacity, and can produce high forage yields. Surface and subsurface drains are needed to remove excess water on the somewhat poorly drained Newark soils and on the very poorly drained Saranac and Sloan soils, particularly if legumes are grown. A drainage system generally is not needed on the better drained Eel and Nolin soils.

The fertility requirements in areas of permanent pasture are similar to those in areas of cropland. Lime and fertilizer should be applied at rates determined by the results of soil tests. Control of weeds by periodic mowing and by applications of recommended herbicide improves the growth of desirable pasture plants. Controlled grazing helps to maintain the pasture plants.

The latest information about seeding mixtures, herbicide treatment, and other management for specific soils can be obtained from the local offices of the Ohio Cooperative Extension Service and the Soil Conservation Service.

Yields per Acre

Donald J. Pettit, soil conservationist, Soil Conservation Service, and Edison L. Klingler, county extension agent, helped prepare this section.

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 *(15)*. Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main 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

Nearly all of Hardin County was forested at the time when it was first surveyed. The climax forest communities on uplands were dominantly beech and maple. Areas of very poorly drained soils, such as Milford and Patton soils, supported a few small swamp forests of elm and ash *(8)*.

In 1984, about 22,000 acres in the county, or 7 percent of the total acreage, was used as woodland *(11)*. Most of the woodland occurs as scattered small woodlots along stream valleys, on flood plains, and in undrained areas on uplands. The stands are dominantly mixed oak, elm, ash, and maple. Most of the woodland has been cut over, and much of it has been grazed.

The potential for increased production of timber in the county is high. If well managed, the woodlots can produce high-quality, fast-growing native hardwoods. Also, many of the woodlots could provide firewood, edible nuts, wildlife habitat, esthetic value, and protection from strong winds.

About 65 percent of the woodland in the county requires some type of conservation treatment *(11)*. Livestock grazing in areas of woodland and inadequate stocking of timber stands are the major management concerns. Measures than can improve the stands include culling the diseased and less desirable trees and cutting and spraying vines to improve the growth of favored species. Harvesting mature trees improves the growth of desirable trees by minimizing plant competition and the potential for disease. The species selected for planting should be those that are suited to the soils. Fencing livestock out of the woodland and providing fire protection help to maintain good stands.

Additional information about forest management is available from 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.

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.

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

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced 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

Several windbreaks have been planted in Hardin County. Some of the well established ones are 20 to 30 years old. Many of these have grown well. Some of them have not grown so well because of improper spacing between the trees or the selection of species that are not suited to the soil. The number of windbreaks in the county has increased in recent years, especially on the mucky soils in the Scioto Marsh. In many of these windbreaks, the trees are well spaced and suitable species have been selected for planting.

Some trees have been planted to enhance the environment. Most of these are around ponds or lakes. A number of areas in the county can be used for environmental plantings, especially those that are so inaccessible or so steep that they generally are not suited to more intensive uses.

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

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

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and on 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

About 1,780 acres in Hardin County is developed for outdoor recreational activities. Most of this acreage is used and owned by hunting and sporting clubs *(10)*. Many community parks throughout the county provide facilities for picnicking, playgrounds, athletic fields, golf courses, outdoor swimming areas, tennis courts, and campgrounds.

The soils in the county generally are moderately well suited to recreational development. They are dominantly deep and are nearly level or gently sloping. They do not have many large stones or a high content of small stones. Most are not subject to flooding and do not have a clayey or sandy surface layer. Many wooded and hilly areas along stream valleys are suitable as scenic sites for camping, hiking, picnicking, and many other outdoor activities. The well drained soils on flood plains have good potential for nature study areas, picnic areas, and paths and trails. The soils that are best suited to these uses are in the Nolin-Eel-Fox association, which is described in the section "General Soil Map Units."

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

J.M. Daugherty, biologist, Ohio Department of Natural Resources, Division of Wildlife, helped prepare this section.

Wildlife habitat is directly related to the kind of soil and land use pattern. The quality, type, and abundance of habitat limit the kinds of species and the populations of wildlife in an area. Many species of wildlife inhabit Hardin County. Most have varied in number over the years because of changes in land use. Cottontail rabbit, bobwhite quail, ring-necked pheasant, eastern meadowlark, and bobolink were once among the most abundant upland wildlife species. The population of these species has declined recently, however, because of changes in land use. The conversion of pasture and hayland to row crop production, the removal of fence rows, and the use of intensified cropping systems have contributed to the loss of upland wildlife habitat. White-tailed deer populations have increased in recent years, partly because of the availability of old pastures and woodlots that are no longer being grazed by livestock.

Figure 11.—Wetland wildlife habitat in an undrained area of Pewamo soils.

Furbearers, such as red fox, gray fox, raccoon, skunk, opossum, and muskrat, also are relatively abundant. Many species of resident and migratory birds nest in the county.

Most areas in the valleys of the Scioto and Blanchard Rivers and their tributaries provide excellent habitat for all of the various kinds of wildlife commonly in the county. Many areas in the Scioto and Hog Creek Marshes provide habitat and staging sites for waterfowl during migration periods. If well managed, all of the soils in the county can provide food and cover for wildlife. In places openland, wetland, and woodland wildlife habitat can be incorporated into a single area to attract the widest variety of wildlife species.

The habitat for wetland wildlife can be further developed in undrained depressions (fig. 11) and in old stream meanders on flood plains. Ponds and marshes provide habitat for songbirds, waterfowl, shore birds, and wetland furbearers. Special plantings help to attract waterfowl. Properly managing the water level can improve the habitat in some of these areas.

Most of the soils on uplands in the county are well suited to the plants that provide food and cover for wildlife. Grassland nesting areas are especially critical. Planting grasses and legumes helps to establish these areas. Additional nesting cover can be provided by delaying the mowing of ditch berms, roadsides, field edges, and pastures until after August 1 in each year. Fruit-bearing shrubs can be planted in hedgerows and field borders to provide winter cover and food. Managing for food-producing trees and leaving hollow den trees improve the value of woodlots as wildlife habitat. If properly managed, cropland also can be valuable as wildlife habitat. Planting grasses, legumes, and shrubs on eroded soils not only helps to control erosion but also provides food and cover for upland wildlife.

Field windbreaks and shelterbelts around farm buildings can provide food and cover for wildlife if they are made up of suitable species. Creating special habitat by providing artificial nesting structures, feeding stations, food patches, and areas of wild flowers can help to attract specific songbirds.

Additional information about the development of wildlife habitat is available from the Ohio Department of Natural Resources and the Soil Conservation Service.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor *(1)*. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and 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, beech, maple, hawthorn, dogwood, hickory, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are honeysuckle, autumn-olive, and crabapple.

Coniferous plants furnish browse 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, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, reed canarygrass, cattails, 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 woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, and mink.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. 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 and 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 soil blowing.

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

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help 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, terraces and diversions, and grassed waterways.

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

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

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

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

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

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and 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.

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

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

Soil Properties

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

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

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.

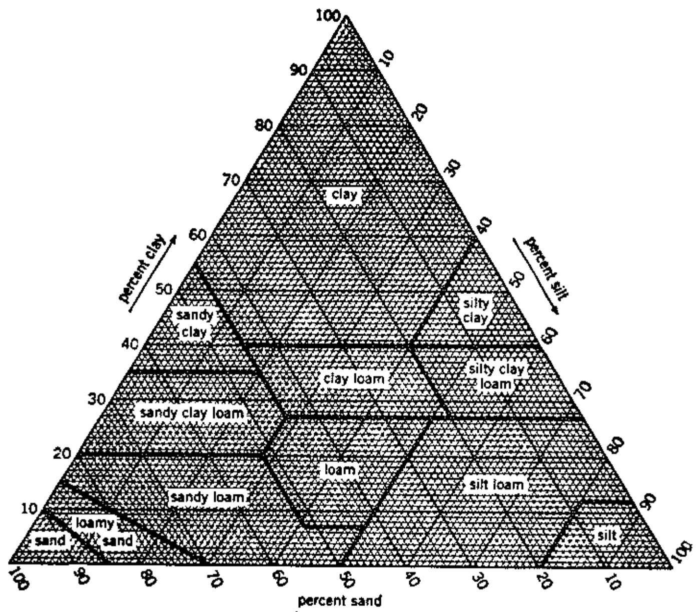

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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. 12). "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.

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

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, 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 soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. 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 soil blowing 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 soil blowing 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 soil blowing 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 soil blowing 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 soil blowing 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 soil blowing 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 soil blowing are used.

8. Soils that are not subject to soil blowing 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

Physical and chemical analyses were made on samples from many soil profiles in Hardin County. The data obtained from most of the samples includes 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 evaluating their behavior under various land uses. Some of the soil profiles that were sampled were selected as representative of their respective series and are described in this survey. These series and their laboratory identification numbers are Colwood series (HD-21), McGuffey series (HD-19, HD-20, and HD 22), Montgomery series (HD-1), and Roundhead series (HD-23).

In addition to the data for Hardin County, laboratory data are available for many of the same soils that occur in nearby counties in the north-central part of Ohio. These data and those for Hardin 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. Some of these data have been published as a part of special studies of the soils in Hardin and nearby counties *(18)*.

Engineering Index Test Data

Engineering index test data are available from several nearby counties that have many of the same soils as Hardin County. These soils were analyzed for engineering properties by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section. The test data 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.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(16)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 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 the typical great group. An example is Aeric Ochraqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. 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 underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(14)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(16)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Belmore Series

The Belmore series consists of deep, well drained, moderately rapidly permeable soils that formed in loamy, water-sorted material underlain by gravelly and loamy deposits. These soils are on outwash terraces, kames, and end moraines. Slope is 6 to 15 percent.

Belmore soils are similar to Martinsville and Ockley soils and commonly are adjacent to Blount, Glynwood, Kendallville, and Morley soils. Blount soils are somewhat poorly drained. They are in hummocky areas in the lower landscape positions. Glynwood soils are moderately well drained. They are on knolls and side slopes in landscape positions similar to those of the Belmore soils. Kendallville soils are less permeable in the underlying material than the Belmore soils. They are in landscape positions similar to those of the Belmore soils but are in less sloping areas. Martinsville soils have less gravel throughout than the Belmore soils. Morley soils have more clay in the subsoil than the Belmore soils. They are on knolls and side slopes. They are mapped in complex with the Belmore soils. Ockley soils are underlain by sand and gravel.

Typical pedon of Belmore loam, in an area of Morley-Belmore complex, 6 to 15 percent slopes, eroded, about 8 miles southwest of Kenton, in Taylor Creek Township; about 430 yards west of the intersection of U.S. Route 68 and Township Road 210:

Ap—0 to 8 inches; dark brown (10YR 3/3) loam, light brownish gray (10YR 6/3) dry; weak medium subangular blocky structure; friable; common fine and very fine roots; about 5 percent coarse fragments; neutral; clear wavy boundary.

Bt—8 to 19 inches; brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; firm; common distinct dark brown (7.5YR 3/4) clay films in pores and on faces of peds; few very fine roots; about 10 percent coarse fragments; mildly alkaline; clear wavy boundary.

2BC1—19 to 33 inches; dark yellowish brown (10YR 4/4) gravelly loam; weak fine subangular blocky structure; friable; few very fine roots; many white (10YR 8/1), weathered limestone fragments; about 20 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

2BC2—33 to 42 inches; brown (10YR 4/3) clay loam; weak coarse subangular blocky structure; firm; few very fine roots; common white (10YR 8/1), weathered limestone fragments; about 10 percent coarse fragments; slight effervescence; moderately alkaline; clear wavy boundary.

2C1—42 to 57 inches; yellowish brown (10YR 5/4) loam stratified with fine sandy loam; massive; friable and firm; few coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

2C2—57 to 80 inches; dark yellowish brown (10YR 4/4) gravelly loam; massive; friable; about 20 percent coarse fragments; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 55 inches. The content of coarse fragments ranges from 5 to 15 percent in the upper part of the solum and from 2 to 40 percent in the underlying material.

The Ap horizon has value of 3 to 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam, loam, or gravelly clay loam. The C horizon has chroma of 3 or 4. It is dominantly loam, gravelly loam, or gravelly sandy loam but has thin strata of fine sandy loam in some pedons.

Blount Series

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

Blount soils are similar to Del Rey soils and commonly are adjacent to Glynwood, Morley, and Pewamo soils. Del Rey soils have a lower content of coarse fragments throughout than the Blount soils. The moderately well drained Glynwood soils and the well drained Morley soils are on the slightly higher or more sloping parts of the landscape. The very poorly drained Pewamo soils are in the lower positions on broad flats, in depressions, and along drainageways. They have a mollic epipedon.

Typical pedon of Blount silt loam, 2 to 6 percent slopes, about 1 mile south of Mt. Victory, in Hale Township; about 520 yards northwest of the intersection of State Route 31 and County Road 240, along State Route 31, then 110 yards west:

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

Bt1—8 to 12 inches; yellowish brown (10YR 5/4) silty clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine and medium roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common distinct brown (10YR 4/3) organic coatings on vertical faces of peds; few coarse fragments; strongly acid; clear smooth boundary.

Bt2—12 to 18 inches; yellowish brown (10YR 5/4) silty clay that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) and common medium and coarse faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; many distinct grayish brown (10YR 5/2) clay films on faces of peds; few very dark gray (10YR 3/1) concretions of iron and manganese oxide; few coarse fragments; very strongly acid; clear wavy boundary.

Bt3—18 to 25 inches; yellowish brown (10YR 5/4) silty clay that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) and common medium and coarse faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common very dark gray (10YR 3/1) concretions and stains of iron and manganese oxide; about 5 percent coarse fragments; medium acid; clear wavy boundary.

BC—25 to 33 inches; yellowish brown (10YR 5/4) silty clay loam; common fine and medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; common very dark gray (10YR 3/1) concretions and stains of iron and manganese oxide; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C—33 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct gray (10YR 5/1) mottles; massive; very firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. The depth to carbonates ranges from 19 to 40 inches. The content of coarse fragments ranges from 0 to 10 percent throughout the profile. The depth to bedrock generally is more than 60 inches. It ranges from 40 to 60 inches, however, in the bedrock substratum phase.

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 2 to 4. It is silty clay, clay, silty clay loam, or clay loam. The BC and C horizons have value of 4 to 6 and chroma of 2 to 4. They are silty clay loam or clay loam.

Carlisle Series

The Carlisle series consists of deep, very poorly drained soils that formed in woody organic deposits in bogs and other depressions on lake plains, till plains, and outwash plains. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Carlisle soils commonly are adjacent to Linwood, Milford, and Wallkill soils. Linwood soils are shallower to mineral material than the Carlisle soils. They are in landscape positions similar to those of the Carlisle soils. Milford soils have a lower content of organic matter than the Carlisle soils. They are on slight rises adjacent to uplands. Wallkill soils formed in recent alluvium over organic material. They are on flood plains or near slope breaks to the uplands.

Typical pedon of Carlisle muck, about 3 miles north of Roundhead, in Roundhead Township; about 330 yards north and 413 yards east of the southwest corner of sec. 16, T. 5 S., R. 9 E.

Op—0 to 10 inches; sapric material, black (10YR 2/1) broken face and rubbed, very dark gray (10YR 3/1) dry; about 10 percent fiber, less than 5 percent rubbed; weak fine granular structure; friable; common fine and medium roots; medium acid; clear wavy boundary.

Oa1—10 to 16 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 10 percent fiber, less than 5 percent rubbed; weak coarse granular structure; friable; few fine roots; slightly acid; gradual wavy boundary.

Oa2—16 to 24 inches; sapric material, black (N 2/0) broken face and rubbed; about 10 percent fiber, 5 percent rubbed; weak coarse granular structure; friable; few fine roots; slightly acid; gradual wavy boundary.

Oa3—24 to 36 inches; sapric material, dark brown (7.5YR 3/2) broken face and rubbed; about 20 percent fiber, 10 percent rubbed; massive; friable; few fine roots; common woody fragments ¼ inch to 3 inches in diameter; slightly acid; clear wavy boundary.

Oa4—36 to 60 inches; sapric material, dark reddish brown (5YR 3/2) broken face and rubbed; thin layers of hemic material; about 30 percent fiber, 15 percent rubbed; massive; friable; common woody fragments ¼ inch to 3 inches in diameter; neutral.

The thickness of the organic material commonly is more than 60 inches. The content of woody fragments generally is less than 15 percent throughout the profile.

The Op horizon has hue of 10YR or 7.5YR and value of 2 or 3. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR or are neutral in hue. They have chroma of 0 to 3.

Colwood Series

The Colwood series consists of deep, very poorly drained soils that formed in loamy glaciofluvial deposits on lake plains. Permeability is moderate. Slope is 0 to 2 percent.

Colwood soils are similar to Westland soils and commonly are adjacent to Milford, Patton, and Roundhead soils. Milford and Patton soils are in landscape positions similar to those of the Colwood soils. Milford soils have more clay than the Colwood soils, and Patton soils have more silt in the subsoil. Roundhead soils have a histic epipedon and have more silt in the subsoil than the Colwood soils. They are in the slightly lower positions on lake plains. Westland soils have more gravel in the subsoil and underlying material than the Colwood soils.

Typical pedon of Colwood loam, about 0.5 mile south of McGuffey, in Marion Township; about 550 yards south and 303 yards east of the northwest corner of sec. 24, T. 4 S., R. 9 E.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; friable; many fine and medium roots; slightly acid; gradual smooth boundary.

A—9 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse granular structure parting to moderate fine and medium granular; friable; common fine roots; slightly acid; clear wavy boundary.

BA—13 to 21 inches; very dark gray (10YR 3/1) loam; common fine distinct brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; friable; common fine roots; common very dark gray (10YR 3/1) organic coatings on faces of peds; common black (10YR 2/1) krotovinas; neutral; clear smooth boundary.

Bg1—21 to 26 inches; gray (5Y 5/1) silty clay loam; common fine and medium distinct light olive brown (2.5Y 5/4) mottles; weak medium angular blocky structure; firm; few fine roots; few distinct dark gray (10YR 4/1) organic coatings on vertical faces of peds; common black (10YR 2/1) krotovinas; neutral; clear smooth boundary.

Bg2—26 to 31 inches; olive gray (5Y 5/2) fine sandy loam; common fine distinct olive (5Y 5/4) and common fine faint gray (5Y 5/1) mottles; weak medium subangular blocky structure; very friable; few fine roots; common black (10YR 2/1) krotovinas; neutral; clear smooth boundary.

BCg—31 to 40 inches; olive gray (5Y 5/2) silt loam; many medium and coarse prominent yellowish brown (10YR 5/8) and few fine distinct gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; common black (10YR 2/1) krotovinas; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg—40 to 60 inches; grayish brown (2.5Y 5/2) silt loam stratified with silty clay loam and loam; common medium prominent yellowish brown (10YR 5/8) mottles; massive; weakly laminated; friable and firm; common white (10YR 8/1) coatings of calcium carbonate in partings; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 50 inches. The mollic epipedon ranges from 10 to 24 inches in thickness.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR, 2.5Y, or 5Y and value of 4 to 6. It is dominantly sandy clay loam, silty clay loam, loam, fine sandy loam, or silt loam, but some pedons have thin subhorizons of clay loam, fine sand, or silty clay. The Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly silt loam stratified with silty clay loam and loam, but some pedons have thin strata of clay loam or loamy sand.

Del Rey Series

The Del Rey series consists of deep, somewhat poorly drained soils that formed in stratified, moderately fine textured and medium textured lacustrine sediment on lake plains. Permeability is slow. Slope is 0 to 3 percent.

Del Rey soils are similar to Blount soils and commonly are adjacent to Latty, Milford, and Shinrock soils. Blount soils have a higher content of coarse fragments throughout than the Del Rey soils. The very poorly drained Latty and Milford soils are on broad flats, in depressional areas, and along drainageways. Latty soils have more clay in the subsoil and underlying material than the Del Rey soils. Milford soils have a mollic epipedon. The moderately well drained Shinrock soils are on the higher and more sloping parts of the landscape.

Typical pedon of Del Rey silt loam, 0 to 3 percent slopes, about 1.5 miles southeast of McVitty, in Jackson Township; about 495 yards north and 55 yards west of the southeast corner of sec. 30, T. 3 S., R. 12 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very pale brown (10YR 7/3) dry; moderate fine and medium granular structure; friable; many fine and medium roots; strongly acid; clear smooth boundary.

BE—8 to 13 inches; yellowish brown (10YR 5/4) silty clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; firm; common fine and medium roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common distinct pale brown (10YR 6/3) silt coatings on faces of peds; common distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; strongly acid; gradual smooth boundary.

Bt1—13 to 20 inches; yellowish brown (10YR 5/6) silty clay that has dark grayish brown (10YR 4/2) coatings on faces of peds; common medium distinct dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common fine and medium roots; many distinct grayish brown (10YR 5/2) clay films on faces of peds; common distinct pale brown (10YR 6/3) silt coatings on vertical faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; strongly acid; gradual smooth boundary.

Bt2—20 to 27 inches; yellowish brown (10YR 5/6) silty clay that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine and medium roots; many distinct grayish brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; slightly acid; gradual smooth boundary.

Bt3—27 to 33 inches; yellowish brown (10YR 5/6) silty clay that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few fine roots; many distinct grayish brown (10YR 5/2) clay films on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; neutral; gradual smooth boundary.

BC—33 to 37 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on vertical faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; common white (10YR 8/1) concretions of secondary calcium carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) silt loam stratified with silty clay loam; common medium distinct gray (10YR 5/1) and common fine faint yellowish brown (10YR 5/6) mottles; massive; weakly laminated; friable and firm; few distinct gray (10YR 5/1) coatings in partings; common very dark gray (10YR 3/1) concretions of iron and manganese oxide in the upper part; common white (10YR 8/1) concretions of secondary calcium carbonate; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 48 inches. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is dominantly silty clay loam or silty clay, but in some pedons it has thin strata of silt loam in the lower part. 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 dominantly silt loam or silty clay loam, but some pedons have thin strata of sandy loam or clay loam.

Eel Series

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

The Eel soils in Hardin County are slightly better drained than is defined in the range for the series. Also, their coarser textures are slightly higher in the profile. These differences, however, do not alter the use or behavior of the soils.

Eel soils are similar to Nolin soils and commonly are adjacent to Fox, Glynwood, and Sloan soils. Fox soils have an argillic horizon and have more gravel in the lower part of the subsoil and in the underlying material than the Eel soils. They are on stream terraces. Glynwood soils have an argillic horizon and have more clay in the subsoil than the Eel soils. They are on low knolls and the side slopes of till plains adjacent to flood plains. Nolin soils are well drained. They have more silt in the subsoil than the Eel soils. Sloan soils are very poorly drained. They are in the lower areas on flood plains and are frequently flooded.

Typical pedon of Eel silt loam, occasionally flooded, about 1.2 miles southwest of Hepburn, in Dudley Township; about 990 yards northwest of the intersection of County Road 219 and Township Road 235, along County Road 219, then 385 yards east:

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common fine and medium roots; many faint dark brown (10YR 3/3) organic coatings on faces of peds; few coarse fragments; neutral; abrupt smooth boundary.

C1—9 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine and medium subangular blocky structure; friable; few fine and medium roots;

common faint brown (10YR 4/3) organic coatings on faces of peds; mildly alkaline; gradual smooth boundary.

C2—20 to 28 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few fine roots; mildly alkaline; gradual smooth boundary.

C3—28 to 35 inches; yellowish brown (10YR 5/4) fine sandy loam; common fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; friable; few fine roots; few coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C4—35 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam stratified with sandy loam in the lower part; common medium and coarse faint grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; friable; few fine roots in the upper part; about 5 percent coarse fragments; slight effervescence; mildly alkaline.

The depth to free carbonates ranges from 26 to 40 inches. The Ap horizon has chroma of 2 or 3. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is silt loam, loam, sandy loam, fine sandy loam, or clay loam. It generally is stratified.

Fox Series

The Fox series consists of deep, well drained soils that formed in loamy deposits over sand and gravel. These soils are on stream terraces, outwash plains, kames, and end moraines. Permeability is moderate in the solum and rapid or very rapid in the underlying material. Slope is 0 to 12 percent.

Fox soils commonly are adjacent to Nolin, Sleeth, and Westland soils. Nolin soils have a cambic horizon. They are on flood plains. Sleeth soils are somewhat poorly drained. They are on slight rises on terraces and outwash plains. Westland soils are very poorly drained. They are on flats and in shallow depressions and drainageways on terraces and outwash plains.

Typical pedon of Fox silt loam, 2 to 6 percent slopes, about 1.5 miles southeast of Roundhead, in Roundhead Township; about 743 yards north of the intersection of Township Roads 47 and 208, along Township Road 47, then 880 yards west:

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

Bt1—10 to 18 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark reddish brown (5YR 3/4) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

Bt2—18 to 24 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; many distinct dark reddish brown (5YR 3/4) clay films on faces of peds; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

Bt3—24 to 31 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark reddish brown (5YR 3/4) clay films on faces of peds; about 15 percent coarse fragments; slightly acid; clear wavy boundary.

Bt4—31 to 38 inches; dark reddish brown (5YR 3/4) gravelly clay loam; weak coarse subangular blocky structure; firm; few fine roots; common faint dark reddish brown (5YR 3/4) clay films on faces of peds; about 25 percent coarse fragments; slight effervescence; mildly alkaline; abrupt irregular boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grained; loose; about 40 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 40 inches. The content of coarse fragments ranges from 0 to 10 percent in the A horizon, from 0 to 30 percent in the Bt horizon, and from 20 to 50 percent in the C horizon.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is dominantly silt loam but is clay loam in eroded areas. The Bt horizon has hue of 5YR, 7.5YR, or 10YR and chroma of 3 or 4. It is clay loam, loam, sandy clay loam, or the gravelly analogs of those textures. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is very gravelly or gravelly sand.

Fulton Series

The Fulton series consists of deep, somewhat poorly drained soils that formed in fine textured lacustrine sediment on lake plains. Permeability is slow or very slow. Slope is 0 to 6 percent.

Fulton soils commonly are adjacent to Del Rey, Haskins, Latty, and Montgomery soils. Del Rey and Haskins soils are in landscape positions similar to those of the Fulton soils. Del Rey soils have less clay in the lower part of the subsoil and in the underlying material than the Fulton soils, and Haskins soils have more sand in the upper part of the subsoil. Latty and Montgomery soils are very poorly drained. They are on broad flats and in depressions and drainageways.

Typical pedon of Fulton silt loam, 0 to 2 percent slopes, about 1 mile east of Patterson, in Jackson Township; about 797 yards east and 303 yards north of the southwest corner of sec. 17, T. 3 S., R. 12 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common fine and medium roots; slightly acid; clear smooth boundary.

Bt1—8 to 14 inches; yellowish brown (10YR 5/4) silty clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on vertical faces of peds; common distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; medium acid; gradual smooth boundary.

Bt2—14 to 20 inches; yellowish brown (10YR 5/4) silty clay that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few distinct dark gray (10YR 4/1) organic coatings on vertical faces of peds; common black (10YR 2/1) concretions of iron and manganese oxide; medium acid; gradual smooth boundary.

Bt3—20 to 27 inches; yellowish brown (10YR 5/4) silty clay that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; neutral; gradual smooth boundary.

Bt4—27 to 32 inches; yellowish brown (10YR 5/4) silty clay; common fine and medium distinct gray (10YR 6/1) and dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct gray (10YR 5/1) clay films on faces of peds; neutral; gradual smooth boundary.

BC—32 to 37 inches; yellowish brown (10YR 5/4) silty clay; common fine and medium distinct gray (10YR 6/1) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; common distinct gray (10YR 5/1) clay films on vertical faces of peds; common white (10YR 8/2) concretions of secondary calcium carbonate; strong effervescence; mildly alkaline; gradual smooth boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct gray (10YR 6/1) mottles; massive; weakly laminated; firm; common distinct gray (10YR 6/1) coatings in partings; common white (10YR 8/2) concretions of secondary calcium carbonate; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 40 inches. The Ap horizon has value of 4 or 5 and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is silty clay, clay, or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is dominantly silty clay or silty clay loam but has thin strata of silt loam, loam, or fine sandy loam in some pedons.

Glynwood Series

The Glynwood series consists of deep, moderately well drained soils that formed in moderately fine textured glacial till on till plains. Permeability is slow. Slope is 2 to 12 percent.

Glynwood soils are similar to Morley and Shinrock soils and commonly are adjacent to Blount, Morley, and Pewamo soils. Blount soils are somewhat poorly drained and are on flats and slight rises. Morley soils are well drained and are in the higher and more sloping areas. Pewamo soils are very poorly drained and are in depressions and along drainageways. They have a mollic epipedon. Shinrock soils have a lower content of coarse fragments in the subsoil and underlying material than the Glynwood soils.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, about 1.3 miles west of Mt. Victory, in Hale Township; about 380 yards south of the intersection of State Route 273 and Township Road 197, along Township Road 197, then 303 yards west:

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

BE—9 to 13 inches; yellowish brown (10YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; common fine and medium roots; common distinct brown (10YR 5/3) clay films on faces of peds; common distinct light gray (10YR 6/1) silt coatings on vertical faces of peds; few coarse fragments; medium acid; clear smooth boundary.

Bt1—13 to 18 inches; yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; firm; common fine and medium roots; many distinct brown (10YR 4/3) clay films on faces of peds; few coarse fragments; slightly acid; gradual smooth boundary.

Bt2—18 to 24 inches; yellowish brown (10YR 5/6) silty clay; common fine and medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; many distinct grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; neutral; gradual smooth boundary.

Bt3—24 to 29 inches; yellowish brown (10YR 5/6) silty clay loam; common fine and medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

BC—29 to 38 inches; yellowish brown (10YR 5/4) clay loam; common fine and 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 on faces of peds; common prominent white (10YR 8/1) coatings of calcium carbonate; about 10 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) clay loam; common fine and medium distinct grayish brown (10YR 5/2) mottles; massive; very firm; few distinct grayish brown (10YR 5/2) coatings in vertical partings; common prominent white (10YR 8/1) coatings of calcium carbonate in partings; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 40 inches. The depth to carbonates ranges from 16 to 36 inches. The content of coarse fragments ranges from 0 to 5 percent in the A horizon, from 0 to 10 percent in the B 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. It is dominantly silt loam but is clay loam in eroded areas. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is dominantly silty clay or clay but has subhorizons of silty clay loam or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is dominantly clay loam but is silty clay loam in some pedons.

Haskins Series

The Haskins series consists of deep, somewhat poorly drained soils that formed in loamy, water-sorted material and in the underlying moderately fine textured glacial till or fine textured lacustrine sediment. These soils are on till plains, lake plains, and terraces. Permeability is moderate in the loamy material and slow or very slow in the moderately fine textured or fine textured material. Slope is 0 to 6 percent.

Haskins soils commonly are adjacent to Blount, Fulton, and Pewamo soils. Blount and Fulton soils have more clay in the upper part of the subsoil than the Haskins soils. They are in landscape positions similar to those of the Haskins soils. Pewamo soils are very poorly drained and are in depressions and drainageways.

Typical pedon of Haskins silt loam, 0 to 2 percent slopes, about 0.3 mile north of Patterson, in Jackson Township; about 440 yards south and 825 yards west of the northeast corner of sec. 18, T. 3 S., R. 12 E.

Ap—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; moderate medium and fine granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

BE—12 to 16 inches; yellowish brown (10YR 5/4) loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; common faint brown (10YR 5/3) silt coatings on faces of peds; few coarse fragments; strongly acid; clear wavy boundary.

Bt1—16 to 19 inches; yellowish brown (10YR 5/6) clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; strongly acid; gradual wavy boundary.

Bt2—19 to 24 inches; yellowish brown (10YR 5/6) clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common fine and medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; medium acid; clear wavy boundary.

2BC—24 to 34 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct gray (10YR 5/1) and common medium faint yellowish brown

(10YR 5/6) mottles; weak coarse and medium subangular blocky structure; firm; common distinct grayish brown (10YR 5/2) clay films on vertical faces of peds; few coarse fragments; neutral; gradual smooth boundary.

2C—34 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct gray (10YR 5/1) mottles; massive; firm; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 25 to 50 inches. Depth to the moderately fine textured or fine textured underlying material ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 20 percent in the upper part of the B horizon and from 0 to 10 percent in the 2B and 2C horizons.

The Ap horizon has chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is dominantly loam, clay loam, or sandy clay loam, but some pedons have thin subhorizons of sandy loam. The 2BC and 2C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. They are silty clay loam, clay loam, clay, or silty clay.

Kendallville Series

The Kendallville series consists of deep, well drained soils that formed in loamy outwash sediment and in the underlying moderately fine textured or medium textured glacial till. These soils are on ground moraines, end moraines, outwash plains, and stream terraces. Permeability is moderately slow. Slope is 2 to 6 percent.

Kendallville soils commonly are adjacent to Blount, Glynwood, Fulton, and Haskins soils. The somewhat poorly drained Blount soils and the moderately well drained Glynwood soils have more clay in the subsoil than the Kendallville soils. They are on uplands. They commonly are in landscape positions similar to those of the Kendallville soils. In some areas, however, Blount soils are in nearly level areas on the lower parts of the landscape. The somewhat poorly drained Fulton soils have more clay throughout the subsoil than the Kendallville soils. The somewhat poorly drained Haskins soils are in the slightly lower landscape positions.

Typical pedon of Kendallville silt loam, 2 to 6 percent slopes, about 3.6 miles north of Kenton, in Pleasant Township; about 220 yards west and 248 yards south of the northeast corner of sec. 16, T. 4 S., R. 11 E.

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

Bt1—10 to 15 inches; dark yellowish brown (10YR 4/4) loam; moderate fine and medium subangular blocky structure; firm; common fine roots; few faint brown (10YR 4/3) clay films on faces of peds; few distinct pale brown (10YR 6/3) silt coatings in pores and on faces of peds; few coarse fragments; strongly acid; gradual smooth boundary.

Bt2—15 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct brown (10YR 4/3) clay films on faces of peds; few faint brown (10YR 5/3) silt coatings in pores and on faces of peds; about 10 percent coarse fragments; strongly acid; clear smooth boundary.

Bt3—24 to 33 inches; brown (7.5YR 4/4) gravelly sandy clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots concentrated in a mass above the contact with till; common distinct brown (7.5YR 4/2) clay bridges between sand grains; few faint grayish brown (10YR 5/2) coatings on faces of peds; about 15 percent coarse fragments; slightly acid; abrupt wavy boundary.

2BC—33 to 38 inches; yellowish brown (10YR 5/4) clay loam; few medium faint yellowish brown (10YR 5/6) and brown (10YR 5/3) mottles; weak medium and coarse subangular blocky structure; firm; few very fine roots in the upper part; few faint brown (10YR 5/3) coatings on vertical faces of peds; few fine distinct light gray (10YR 7/2) coatings of calcium carbonate on faces of peds; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

2C—38 to 60 inches; yellowish brown (10YR 5/4) clay loam; few medium faint yellowish brown (10YR 5/6) and brown (10YR 5/3) mottles; massive; firm; grayish brown (10YR 5/2) coatings in vertical partings; few fine distinct light gray (10YR 7/2) coatings of calcium carbonate in partings; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 25 to 40 inches. It commonly is the same as the depth to carbonates. The content of coarse fragments ranges from 10 to 25 percent in the outwash material and from 2 to 10 percent in the underlying glacial till.

The A horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, clay loam, sandy clay loam, or the gravelly analogs of those textures. The 2BC and 2C horizons have value of 4 or 5 and chroma of 3 to 6. They are clay loam or loam glacial till.

Kibbie Series

The Kibbie series consists of deep, somewhat poorly drained soils that formed in loamy glaciofluvial deposits on lake plains, till plains, and outwash plains. Permeability is moderate. Slope is 0 to 3 percent.

Kibbie soils commonly are adjacent to Del Rey and Milford soils. Del Rey soils have more clay in the subsoil than the Kibbie soils and have an ochric epipedon. They are in landscape positions similar to those of the Kibbie soils. Milford soils have more clay in the solum than the Kibbie soils. They are very poorly drained and are on broad flats and in drainageways and depressions.

Typical pedon of Kibbie loam, 0 to 3 percent slopes, about 2.8 miles northeast of Ada, in Liberty Township; about 798 yards west and 330 yards south of the northeast corner of sec. 13, T. 3 S., R. 9 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; few fine and medium roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium distinct yellowish brown (10YR 5/8) and grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; friable; few fine and medium roots; few distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) clay films on faces of peds; common very dark gray (N 3/0) stains of iron and manganese oxide; few very dark grayish brown (10YR 3/2) wormcasts; slightly acid; gradual smooth boundary.

Bt2—15 to 21 inches; brown (10YR 5/3) sandy clay loam that has dark grayish brown (10YR 4/2) coatings on faces of peds; common medium faint grayish brown (10YR 5/2) and common medium and coarse prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few fine roots; common distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) clay films on faces of peds; common distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; common very dark gray (N 3/0) stains of iron and manganese oxide; slightly acid; gradual smooth boundary.

Bt3—21 to 26 inches; yellowish brown (10YR 5/4) sandy clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium and coarse distinct yellowish brown (10YR 5/8) and common fine and medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few faint dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; many dark yellowish brown (10YR 4/4) stains of iron and manganese oxide; slightly acid; gradual smooth boundary.

Bt4—26 to 31 inches; brown (10YR 5/3) clay loam that has gray (10YR 4/1) coatings on faces of peds; common medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common distinct dark gray (10YR 4/1) clay films on faces of peds; common very dark gray (7.5YR 3/1) stains of iron and manganese oxide; neutral; gradual smooth boundary.

Bt5—31 to 38 inches; brown (10YR 5/3) loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few faint grayish brown (10YR 5/2) clay films on faces of peds; few dark brown (7.5YR 3/2) stains of iron and manganese oxide; neutral; clear smooth boundary.

BC—38 to 45 inches; yellowish brown (10YR 5/6) silt loam; common medium distinct light brownish gray (10YR 6/2) mottles; weak medium and coarse subangular blocky structure; firm; few distinct gray (10YR 5/1) coatings on faces of peds; common white (10YR 8/1) concretions of secondary calcium carbonate; strong effervescence; mildly alkaline; gradual smooth boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4) silt loam that has thin strata of loam; common medium and coarse distinct gray (10YR 6/1) and common medium distinct yellowish brown (10YR 5/8) mottles; massive; firm; few white (10YR 8/1) concretions of secondary calcium carbonate; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 26 to 48 inches. The Ap horizon has value of 2 or 3 and chroma of 1 to 3. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is loam, sandy clay loam, clay loam, or silt loam and has strata of fine sandy loam. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is dominantly silt loam, loam, or sandy loam but has thin strata of sandy clay loam or silty clay loam in some pedons.

Latty Series

The Latty series consists of deep, very poorly drained soils that formed in fine textured lacustrine sediment on lake plains. Permeability is very slow. Slope is 0 to 2 percent.

Latty soils are similar to Montgomery soils and commonly are adjacent to Del Rey and Fulton soils. Del Rey and Fulton soils are somewhat poorly drained. They are on slight rises and low knolls. Montgomery soils have a mollic epipedon.

Typical pedon of Latty silty clay loam, about 0.6 mile south of Bridgeport, in Blanchard Township; about 798 yards north and 825 yards west of the southeast corner of sec. 33, T. 4 S., R. 11 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; firm; few fine roots; intermixed with flecks of yellowish brown (10YR 5/4) subsoil material; slightly acid; clear wavy boundary.

Bg1—10 to 16 inches; gray (10YR 5/1) silty clay; common medium prominent light olive brown (2.5Y 5/4) and few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few fine roots; few faint dark gray (10YR 4/1) coatings on vertical faces of peds; few very dark gray (N 3/0) krotovinas; slightly acid; clear wavy boundary.

Bg2—16 to 27 inches; dark gray (10YR 4/1) silty clay; common medium distinct olive brown (2.5Y 4/4) and few fine prominent light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; very firm; few fine roots; many distinct very dark grayish brown (10YR 3/2) and few faint dark gray (10YR 4/1) coatings on vertical faces of peds; few very dark gray (N 3/0) krotovinas; slightly acid; gradual wavy boundary.

Bg3—27 to 41 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct olive brown (2.5Y 4/4) and common medium distinct dark gray (N 4/0) and yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; very firm; few very fine roots; common distinct dark gray (10YR 4/1) coatings on vertical faces of peds; few very dark gray (N 3/0) krotovinas; neutral; gradual smooth boundary.

Bg4—41 to 47 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent yellowish brown (10YR 5/6) and common medium distinct olive brown (2.5Y 4/4) and dark gray (N 4/0) mottles; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few very fine roots; common distinct dark gray (10YR 4/1) coatings on vertical faces of peds; few very dark gray (N 3/0) krotovinas; mildly alkaline; gradual wavy boundary.

BCg—47 to 58 inches; gray (10YR 5/1) silty clay; many medium distinct olive brown (2.5Y 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; common faint gray (10YR 5/1) coatings on vertical faces of peds; few very dark gray (N 3/0) krotovinas; few prominent light gray (10YR 7/2) coatings of lime on faces of peds and concretions of lime in the matrix; strong effervescence; mildly alkaline; gradual smooth boundary.

C—58 to 60 inches; olive brown (2.5Y 4/4) silty clay; common medium distinct grayish brown (2.5Y 5/2) and common fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; few distinct gray (10YR 5/1) coatings in vertical partings; few prominent light gray (10YR 7/2) coatings of lime in partings and concretions of lime in the matrix; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 32 to 60 inches. The Ap horizon has chroma of 1 or 2. It is silty clay loam or silty clay. The Bg and Cg horizons are silty clay or clay. The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4.

Linwood Series

The Linwood series consists of deep, very poorly drained soils that formed in organic material overlying medium textured lacustrine sediment. These soils generally are on lake plains and in marshes. In a few areas, however, they are in depressions on till plains and outwash plains. Permeability is moderately slow to moderately rapid in the organic material and moderately slow or moderate in the underlying lacustrine sediment. Slope is 0 to 1 percent.

Linwood soils commonly are adjacent to Carlisle and Roundhead soils. The adjacent soils are in landscape positions similar to those of the Linwood soils. Carlisle soils have organic plant material throughout the control section. Roundhead soils have a histic epipedon and a cambic horizon.

Typical pedon of Linwood muck, about 1 mile northwest of Jump, in Roundhead Township; about 660 yards south and 495 yards west of the northeast corner of sec. 10, T. 3 S., R. 9 E.

Op—0 to 11 inches; sapric material, black (10YR 2/1) broken face and rubbed, very dark gray (10YR 3/1) dry; about 5 percent fiber, 0 percent rubbed; moderate medium granular structure; friable; many fine and medium roots; neutral; gradual smooth boundary.

Oa—11 to 18 inches; sapric material, dark reddish brown (5YR 3/2) broken face and rubbed; about 15 percent fiber, 3 percent rubbed; weak coarse subangular blocky structure parting to moderate medium granular; friable; many fine and medium roots; strongly acid; clear smooth boundary.

Cg1—18 to 27 inches; dark grayish brown (10YR 4/2) coprogenous earth (sedimentary peat); common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak medium angular blocky; firm; common fine and medium roots; slightly plastic; strongly acid; clear smooth boundary.

2Cg2—27 to 33 inches; gray (10YR 5/1) silt loam; common medium prominent brown (7.5YR 4/4) mottles; massive; friable; few fine roots; common fine white (10YR 8/1) aquatic shells; strong effervescence; moderately alkaline; gradual smooth boundary.

2Cg3—33 to 60 inches; gray (5Y 5/1) silt loam; common fine distinct yellowish brown (10YR 5/4 and 5/8) mottles; massive; friable; few fine roots; violent effervescence; moderately alkaline.

The thickness of the organic material ranges from 16 to 38 inches. The thickness of the coprogenous earth (sedimentary peat) ranges from 2 to 25 inches. Depth to the silty mineral material ranges from 20 to 40 inches.

The O horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2. The Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 or 4, and chroma of 1 or 2. The 2Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly silt loam, but some pedons have thin strata of loam, fine sandy loam, or clay loam.

Martinsville Series

The Martinsville series consists of deep, well drained soils that formed in stratified, loamy sediment. These soils generally are on stream terraces, lake plains, and outwash plains. In a few areas, however, they are on moraines. Permeability is moderate. Slope is 1 to 4 percent.

Martinsville soils are similar to Belmore and Ockley soils and commonly are adjacent to Kibbie and Milford soils. Belmore soils have more gravel in the lower part of the subsoil and in the underlying material than the Martinsville soils. Kibbie soils are somewhat poorly drained and are on low knolls and slight rises. Milford soils are very poorly drained and are in depressions, along drainageways, and on broad flats. They have a mollic epipedon. Ockley soils have a higher content of coarse fragments throughout than the Martinsville soils and are coarser textured in the underlying material.

Typical pedon of Martinsville loam, 1 to 4 percent slopes, about 1.7 miles north of Kenton, in Pleasant Township; about 248 yards east and 55 yards south of the northwest corner of sec. 28, T. 4 S., R. 11 E.

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

Bt1—10 to 15 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; few fine roots; few faint brown (10YR 4/3) clay films on faces of peds and in pores; few coarse fragments; slightly acid; clear wavy boundary.

Bt2—15 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct brown (10YR 4/3) clay films on faces of peds and in pores; few coarse fragments; neutral; clear wavy boundary.

Bt3—26 to 37 inches; dark yellowish brown (10YR 4/4) loam; weak medium and coarse subangular blocky structure; friable; few fine roots; few distinct brown (10YR 4/3) clay films on vertical faces of peds and bridging sand grains; few coarse fragments; neutral; gradual smooth boundary.

Bt4—37 to 52 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak coarse subangular blocky structure; friable; few very fine roots; dark brown (7.5YR 3/2) clay bridges between sand grains; few coarse fragments; neutral; gradual wavy boundary.

BC—52 to 59 inches; dark yellowish brown (10YR 4/4) sandy loam that has strata of silt loam; common medium distinct yellowish brown (10YR 5/6) and brown (10YR 5/3) mottles; weak coarse subangular blocky structure; friable; few very fine roots; common faint dark brown (10YR 3/3) bodies that have common clay bridges between sand grains; few coarse fragments; mainly neutral, but moderately alkaline in the strata of silt loam; gradual wavy boundary.

C—59 to 70 inches; yellowish brown (10YR 5/4) and grayish brown (10YR 5/2), stratified silt loam, fine sandy loam, and loamy fine sand; massive; very friable; weak effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is clay loam, silty clay loam, or sandy clay loam in the upper part and loam or sandy clay loam in the lower part. The BC horizon has value of 4 or 5. It is silt loam or sandy loam. The C horizon has value of 4 to 6 and chroma of 2 to 6. It is stratified loamy fine sand, fine sandy loam, loam, or silt loam.

McGuffey Series

The McGuffey series consists of deep, very poorly drained soils that formed in a thin layer of organic material and in the underlying fine textured lacustrine sediment. These soils generally are on lake plains and in marshes. In a few areas, however, they are in depressions on till plains and outwash plains. Permeability is very slow in the lacustrine material. Slope is 0 to 1 percent.

McGuffey soils commonly are adjacent to Montgomery, Pewamo Variant, and Roundhead soils. Montgomery soils have a mollic epipedon and are deeper to free carbonates than the McGuffey soils. They are very poorly drained and are on very slight rises on the perimeter of lake plains. Pewamo Variant and Roundhead soils are in landscape positions similar to those of the McGuffey soils. They have less clay in the subsoil and underlying material than the McGuffey soils. Also, Pewamo Variant soils have a higher content of coarse fragments in the subsoil and underlying material.

Typical pedon of McGuffey muck, about 2 miles southwest of McGuffey, in Marion Township; about 467 yards east and 192 yards north of the southwest corner of sec. 22, T. 4 S., R. 9 E.

Op—0 to 10 inches; sapric material, black (10YR 2/1) broken face and rubbed, black (10YR 2/1) dry; moderate fine and medium granular structure; very friable; many fine and medium roots; neutral; abrupt smooth boundary.

Bg1—10 to 17 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and light gray (10YR 6/1) mottles; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; very firm; few fine and medium roots; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; common medium distinct light gray (10YR 7/2) gypsum crystals in old root channels and on the faces of some peds; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg2—17 to 33 inches; grayish brown (2.5Y 5/2) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very firm; few fine roots; common medium distinct light gray (10YR 7/2) gypsum crystals in old root channels and on the faces of some peds; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg—33 to 60 inches; gray (10YR 5/1) silty clay in the upper part and silty clay loam in the lower part; common medium distinct olive brown (2.5Y 4/4) mottles; massive; weakly laminated; very firm; common medium distinct light gray (10YR 7/2) gypsum crystals and dark yellowish brown (10YR 4/4) coatings of iron oxide in old root channels; strong effervescence; moderately alkaline.

The thickness of the histic epipedon ranges from 8 to 15 inches. It commonly is the same as the depth to free carbonates. The thickness of the solum ranges from 15 to 40 inches.

The Op horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. Some pedons have an Oa horizon, which is as much as 15 inches thick. The Bg horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is dominantly silty clay, clay, or silty clay loam, but some pedons have thin strata of silt loam, loam, clay loam, or fine sandy loam. The Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly silty clay, silty clay loam, or clay, but some pedons have thin strata of silt loam or fine sandy loam.

Milford Series

The Milford series consists of deep, very poorly drained soils that formed in stratified, moderately fine textured and medium textured lacustrine sediment. These soils generally are on lake plains. In a few areas, however, they are in closed depressions on till plains. Permeability is moderately slow. Slope is 0 to 2 percent.

Milford soils are similar to Patton and Pewamo soils and commonly are adjacent to Del Rey, Montgomery, Patton, and Pewamo soils. Del Rey soils are somewhat poorly drained. They are on slight rises and low knolls. Montgomery, Patton, and Pewamo soils are in landscape positions similar to those of the Milford soils. Montgomery soils have more clay in the lower part of the subsoil and in the underlying material than the Milford soils, Patton soils have less clay in the subsoil, and Pewamo soils have coarse fragments throughout.

Typical pedon of Milford silty clay loam, about 2.5

miles northwest of Roundhead, in Roundhead Township; about 550 yards east and 385 yards south of the northwest corner of sec. 30, T. 5 S., R. 9 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium and fine granular structure; firm; common fine and medium roots; medium acid; clear smooth boundary.

BA—10 to 15 inches; very dark grayish brown (2.5Y 3/2) silty clay; common fine and medium distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate fine and medium angular; firm; few fine roots; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; common very dark gray (10YR 3/1) krotovinas; slightly acid; gradual smooth boundary.

Bg1—15 to 20 inches; dark gray (5Y 4/1) silty clay; common fine prominent olive brown (2.5Y 4/4) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common faint dark gray (10YR 4/1) organic coatings on faces of primary peds; common very dark gray (10YR 3/1) krotovinas; neutral; gradual smooth boundary.

Bg2—20 to 27 inches; dark gray (5Y 4/1) silty clay; common medium prominent yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common faint dark gray (5Y 4/1) stress surfaces on primary peds; common faint dark gray (10YR 4/1) organic coatings on faces of primary peds; neutral; clear smooth boundary.

Bg3—27 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium and coarse prominent yellowish brown (10YR 5/6) and common fine and medium distinct gray (5Y 5/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common faint gray (N 5/0) stress surfaces on primary peds; neutral; gradual smooth boundary.

Bg4—33 to 39 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium and coarse distinct yellowish brown (10YR 5/6) and common fine and medium distinct gray (N 5/0) mottles; weak very coarse prismatic structure parting to moderate medium subangular blocky; firm; neutral; gradual smooth boundary.

BCg—39 to 53 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and common medium distinct gray (N 5/0) mottles; weak medium subangular blocky structure; firm; neutral; clear smooth boundary.

Cg—53 to 60 inches; gray (5Y 5/1) silty clay loam stratified with silt loam; common medium prominent yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; massive; firm; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 55 inches. The thickness of the mollic epipedon ranges from 12 to 18 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 2.5Y, 5Y, or 10YR or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is silty clay or silty clay loam. The Cg horizon has hue of 2.5Y, 5Y, or 10YR, value of 4 to 6, and chroma of 1 or 2. It is dominantly silty clay loam but has thin strata of silt loam or clay loam.

Millsdale Series

The Millsdale series consists of moderately deep, very poorly drained soils that formed in glacial drift over limestone. These soils are on till plains and low stream terraces. Permeability is moderately slow. Slope is 0 to 2 percent.

The Millsdale soils in Hardin County are taxadjuncts because they do not have an argillic horizon. This difference, however, does not alter the use or behavior of the soils.

Millsdale soils commonly are adjacent to Blount, Milton, Morley, Pewamo, and Sloan soils. Blount, Milton, and Morley soils are better drained than the Millsdale soils. They are on the higher or more sloping parts of the landscape. Pewamo soils are in positions on till plains similar to those of the Millsdale soils. Sloan soils that formed in loamy alluvium on flood plains. Blount, Morley, Pewamo, and Sloan soils are deep over bedrock.

Typical pedon of Millsdale silty clay loam, about 2.8 miles northwest of Ada, in Liberty Township; about 330 yards north and 1,075 feet west of the southeast corner of sec. 7, T. 3 S., R. 9 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; firm; common fine and medium roots; slightly acid; clear smooth boundary.

A—10 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; firm; few fine and medium roots; common faint very dark gray (10YR 3/1) organic coatings on vertical faces of peds; slightly acid; clear smooth boundary.

Bg1—14 to 20 inches; dark gray (10YR 4/1) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; common distinct very dark grayish brown (10YR 3/2) organic coatings on vertical faces of peds; slightly acid; gradual smooth boundary.

Bg2—20 to 27 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; few fine and medium roots; common distinct very dark grayish brown (10YR 3/2) organic coatings on vertical faces of peds; slightly acid; gradual smooth boundary.

Bg3—27 to 35 inches; dark gray (10YR 4/1) silty clay loam; common fine and medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; few coarse fragments; neutral; abrupt smooth boundary.

2R—35 to 40 inches; hard limestone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The thickness of the mollic epipedon ranges from 10 to 18 inches. The content of coarse fragments ranges from 0 to 10 percent in the solum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay loam.

Milton Series

The Milton series consists of moderately deep, well drained soils that formed in moderately fine textured glacial till over limestone bedrock. These soils are on ground moraines and end moraines. Permeability is moderate or moderately slow. Slope is 2 to 6 percent.

Milton soils commonly are adjacent to Blount, Millsdale, and Morley soils. Blount soils are deep and somewhat poorly drained. They are on the lower or less sloping parts of the landscape. Morley soils are deep over bedrock. They are in landscape positions similar to those of the Milton soils and on the more sloping parts of the landscape. Millsdale soils are very poorly drained. They are in depressions and along drainageways.

Typical pedon of Milton silt loam, in an area of Morley-Milton silt loams, 2 to 6 percent slopes, about 0.9 mile northwest of Blanchard, in Blanchard Township; about 410 yards east and 243 yards south of the northwest corner of sec. 31, T. 3 S., R. 11 E.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; many fine and medium roots; few coarse fragments; slightly acid; clear smooth boundary.

BE—7 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium and fine subangular blocky structure; firm; many fine and medium roots; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few faint brown (10YR 5/3) silt coatings on faces of peds; common distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; few coarse fragments; medium acid; clear smooth boundary.

Bt1—11 to 15 inches; brown (7.5YR 4/4) clay; moderate medium subangular blocky structure; firm; common fine and medium roots; many distinct dark yellowish brown (10YR 4/4) clay films of faces of peds; few faint brown (10YR 5/3) silt coatings on vertical faces of peds; few coarse fragments; strongly acid; gradual smooth boundary.

Bt2—15 to 23 inches; dark yellowish brown (10YR 4/4) clay; strong medium subangular blocky structure; firm; common fine and medium roots; many distinct brown (10YR 4/3) clay films on faces of peds; few distinct grayish brown (10YR 5/2) silt coatings on vertical faces of peds; few coarse fragments; neutral; gradual smooth boundary.

Bt3—23 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; many distinct brown (10YR 4/3) clay films on faces of peds; common distinct white (10YR 8/1) coatings of calcium carbonate on faces of peds; few coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

BC—28 to 33 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; common distinct brown (10YR 4/3) clay films on vertical faces of peds; common fine and medium distinct white (10YR 8/1) coatings of calcium carbonate on faces of peds; about 10 percent coarse fragments; strong effervescence; mildly alkaline; abrupt wavy boundary.

R—33 to 40 inches; hard limestone bedrock.

The thickness of the solum ranges from 20 to 40 inches. It generally is the same as the depth to bedrock. The content of coarse fragments ranges from 0 to 10 percent in the B horizon and from 5 to 10 percent in the C horizon.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam, silty clay, clay, or clay loam. Some pedons have a C horizon, which is clay loam or silty clay loam.

Montgomery Series

The Montgomery series consists of deep, very poorly drained soils that formed in fine textured lacustrine sediment. These soils generally are on lake plains. In a few areas, however, they are in deep, closed depressions on till plains, and areas of a gravelly substratum phase are on outwash plains and slack-water terraces. Permeability generally is slow, but it is rapid in the underlying material of the gravelly substratum phase. Slope is 0 to 2 percent.

Montgomery soils are similar to Latty soils and commonly are adjacent to McGuffey, Milford, and Pewamo soils. Latty soils have an ochric epipedon. They are in landscape positions similar to those of the Montgomery soils. McGuffey soils have a histic epipedon and are shallower to free carbonates than the Montgomery soils. They are in broad, flat depressions on lake plains. Milford and Pewamo soils have less clay in the lower part of the subsoil and in the underlying material than the Montgomery soils. They are in landscape positions similar to those of the Montgomery soils.

Typical pedon of Montgomery silty clay loam, about 1.25 miles south of Alger, in Marion Township; about 165 yards south and 110 yards east of the northwest corner of sec. 21, T. 4 S., R. 9 E.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate medium granular; firm; common fine and medium roots; neutral; clear smooth boundary.

BA—10 to 18 inches; very dark gray (10YR 3/1) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; few fine roots; common faint black (10YR 2/1) organic coatings on vertical faces of peds; neutral; clear smooth boundary.

Bg1—18 to 26 inches; gray (10YR 5/1) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common faint gray (10YR 5/1) stress surfaces on vertical faces of primary peds; common black (10YR 2/1) krotovinas; neutral; gradual smooth boundary.

Bg2—26 to 32 inches; gray (10YR 6/1) silty clay; common medium and coarse prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common faint gray (10YR 5/1) stress surfaces on vertical faces of primary peds; common black (10YR 2/1) krotovinas; neutral; gradual smooth boundary.

Bg3—32 to 39 inches; gray (10YR 6/1) silty clay; common medium and coarse prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common faint gray (10YR 5/1) stress surfaces on vertical faces of primary peds; common black (10YR 2/1) krotovinas; common white (10YR 8/1) concretions of secondary calcium carbonate; weak effervescence; mildly alkaline; gradual smooth boundary.

BCg—39 to 46 inches; gray (10YR 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; common black (10YR 2/1) krotovinas; common white (10YR 8/1) concretions of secondary calcium carbonate; strong effervescence; mildly alkaline; gradual smooth boundary.

C—46 to 60 inches; olive brown (2.5Y 4/4) silty clay loam; common medium prominent gray (10YR 6/1) mottles; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 or 2. It is silty clay 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 4. It generally is silty clay loam or silty clay. In the gravelly substratum phase, the BCg horizon is clay loam or gravelly clay loam and the Cg horizon is gravelly sandy loam or gravelly loamy sand.

Morley Series

The Morley series consists of deep, well drained soils that formed in moderately fine textured glacial till on till plains. Permeability is slow or moderately slow. Slope is 2 to 18 percent.

Morley soils are similar to Glynwood soils and commonly are adjacent to Blount, Glynwood, Milton, and Pewamo soils. The somewhat poorly drained Blount soils are in the less sloping or lower areas. Glynwood and Milton soils are in landscape positions similar to those of the Morley soils. Glynwood soils are moderately well drained. Milton soils have limestone bedrock at a depth of 20 to 40 inches. The very poorly drained Pewamo soils are in depressions and along drainageways.

Typical pedon of Morley clay loam, 12 to 18 percent slopes, eroded, about 0.6 mile northwest of Patterson, in Jackson Township; about 58 yards north and 825 yards east of the southwest corner of sec. 7, T. 3 S., R. 12 E.

Ap—0 to 8 inches; brown (10YR 4/3) clay loam, pale brown (10YR 6/3) dry; moderate medium granular structure; firm; many fine and medium roots; few coarse fragments; neutral; abrupt wavy boundary.

Bt1—8 to 13 inches; dark yellowish brown (10YR 4/4) clay loam; common fine and medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine and medium roots; common distinct brown (10YR 4/3) clay films on faces of peds; few coarse fragments; neutral; clear wavy boundary.

Bt2—13 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine and medium roots; common distinct brown (10YR 4/3) clay films on faces of peds; few coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

BC—20 to 35 inches; yellowish brown (10YR 5/4) clay loam; common medium faint yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; common faint brown (10YR 5/3) clay films on faces of peds; about 5 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C—35 to 60 inches; yellowish brown (10YR 5/4) clay loam; common fine and medium distinct grayish brown (10YR 5/2) and common fine and medium faint yellowish brown (10YR 5/6) mottles; massive; very firm; common distinct light gray (10YR 7/2) coatings of calcium carbonate in partings; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to free carbonates ranges from 12 to 30 inches.

The Ap horizon has chroma of 2 or 3. It is clay loam or silt loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, clay, silty clay loam, or silty clay. The C horizon has value of 5 or 6 and chroma of 2 to 6. It is dominantly clay loam, but in some pedons it is silty clay loam.

Newark Series

The Newark series consists of deep, somewhat poorly drained, moderately permeable soils that formed in medium textured alluvium on flood plains. Slope is 0 to 2 percent.

Newark soils commonly are adjacent to Blount, Glynwood, and Nolin soils. Blount and Glynwood soils have more clay in the subsoil than the Newark soils. They are on side slopes on uplands adjacent to flood plains along streams. Nolin soils are well drained. They are in landscape positions similar to those of the Newark soils or are in the slightly higher landscape positions.

Typical pedon of Newark silt loam, occasionally flooded, about 3.4 miles northeast of Hepburn, in Goshen Township; about 300 yards west and 93 yards north of the southeast corner of sec. 36, T. 4 S., R. 12 E.

A—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; friable; common fine and very fine roots; slightly acid; clear wavy boundary.

Bw—8 to 13 inches; yellowish brown (10YR 5/4) silt loam; common medium faint yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; common very fine roots; many distinct light brownish gray (10YR 6/2) silt coatings on faces of peds; few distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; few black (10YR 2/1) concretions of iron and manganese oxide; medium acid; clear wavy boundary.

Bg1—13 to 25 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and many medium faint brown (10YR 5/3) mottles; moderate medium and fine subangular blocky structure; firm; few very fine roots; common distinct grayish brown (10YR 5/2) silt coatings on faces of peds; few distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; few black (10YR 2/1) concretions of iron and manganese oxide; slightly acid; gradual wavy boundary.

Bg2—25 to 43 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; moderate coarse and medium subangular blocky structure; firm; few very fine roots; few distinct dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; mildly alkaline; gradual wavy boundary.

Cg—43 to 60 inches; dark gray (10YR 4/1) silty clay loam; many coarse prominent yellowish brown

(10YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; mildly alkaline.

The thickness of the solum ranges from 32 to 44 inches. Most pedons do not have coarse fragments in the solum, but they have as much as 20 percent coarse fragments below a depth of 40 inches.

The B horizon has value of 4 or 5 and chroma of 1 to 4. It is silt loam or silty clay loam. The C horizon has value of 4 or 5 and chroma of 1 to 4. It is dominantly silt loam or silty clay loam, but some pedons have thin strata of loam.

Nolin Series

The Nolin series consists of deep, well drained soils that formed in medium textured alluvium on flood plains. Permeability is moderate. Slope is 0 to 2 percent.

The Nolin soils in Hardin County are more alkaline in the upper part of the solum than is defined as the range for the series. This difference, however, does not alter the use or behavior of the soils.

Nolin soils are similar to Eel soils and commonly are adjacent to Blount, Fox, Glynwood, and Saranac soils. The somewhat poorly drained Blount soils and the moderately well drained Glynwood soils are on side slopes adjacent to flood plains. They have more clay in the control section than the Nolin soils. The moderately well drained Eel soils have more sand in the control section than the Nolin soils. Fox soils are on stream terraces. They have more sand and gravel in the subsoil and underlying material than the Nolin soils. The very poorly drained Saranac soils are in the lower or depressional areas on the flood plains.

Typical pedon of Nolin silt loam, occasionally flooded, about 1.3 miles west of Pfeiffer Station, in Dudley Township; about 660 yards east of the intersection of Township Roads 146 and 199, along Township Road 146, then 110 yards north:

Ap—0 to 10 inches; silt loam, dark grayish brown (10YR 4/2) crushed, light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; friable; many fine and medium roots; many faint very dark grayish brown (10YR 3/2) organic coatings on faces of peds; slight effervescence; mildly alkaline; gradual smooth boundary.

A—10 to 18 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; friable; common fine and medium roots; common faint very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common distinct very dark grayish brown (10YR 3/2) wormcasts and worm channels; thin strata of light yellowish brown (10YR 6/4) silt; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw1—18 to 26 inches; brown (10YR 4/3) silt loam; weak medium subangular blocky structure parting to moderate fine and medium granular; friable; few fine and medium roots; common distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; common very dark grayish brown (10YR 3/2) wormcasts and worm channels; mildly alkaline; gradual smooth boundary.

Bw2—26 to 33 inches; brown (10YR 4/3) silt loam; moderate fine and medium subangular blocky structure; friable; few fine roots; common faint dark brown (10YR 3/3) organic coatings on faces of peds; common dark brown (10YR 3/3) wormcasts and worm channels; mildly alkaline; gradual smooth boundary.

Bw3—33 to 40 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; friable; few fine roots; common faint dark brown (10YR 3/3) organic coatings on faces of peds; few dark brown (10YR 3/3) wormcasts and worm channels; mildly alkaline; gradual smooth boundary.

Bw4—40 to 47 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; friable; few fine roots; few faint dark brown (10YR 3/3) organic coatings on faces of peds; few dark brown (10YR 3/3) wormcasts and worm channels; neutral; clear smooth boundary.

C—47 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; massive; friable; few faint brown (10YR 5/3) coatings in partings; few dark brown (7.5YR 3/2) stains of iron and manganese oxide; neutral.

The thickness of the solum ranges from 40 to 55 inches. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. The C horizon has value of 4 or 5 and chroma of 2 to 4. It is dominantly silty clay loam or silt loam, but it has thin strata of fine sandy loam or loam in some pedons.

Ockley Series

The Ockley series consists of deep, well drained soils that formed in loamy outwash and in the underlying sandy and gravelly, calcareous glacial outwash. These soils are on stream terraces, kames, and outwash plains. Permeability is moderate in the solum and very rapid in the underlying material. Slope is 0 to 6 percent.

Ockley soils are similar to Belmore and Martinsville soils and commonly are adjacent to Kibbie and Sleeth soils. Belmore soils have more silt and clay in the underlying material than the Ockley soils. Kibbie soils have a lower content of coarse fragments throughout than the Ockley soils. They are somewhat poorly drained and are on slight rises and low knolls. Martinsville soils have less gravel throughout than the Ockley soils and have more silt in the underlying material. Sleeth soils are somewhat poorly drained and are on slight rises and low knolls.

Typical pedon of Ockley loam, 2 to 6 percent slopes, about 2.7 miles north of Kenton, in Pleasant Township; about 440 yards south and 495 yards east of the northwest corner of sec. 21, T. 4 S., R. 11 E.

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

Bt1—9 to 16 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; few very fine roots; few faint brown (10YR 4/3) clay films on vertical faces of peds; many distinct brown (10YR 4/3) coatings on faces of peds; common faint brown (10YR 4/3) organic coatings in root channels; few coarse fragments; medium acid; gradual smooth boundary.

Bt2—16 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few very fine roots; common distinct dark brown (7.5YR 4/2) clay films on faces of peds; common distinct brown (10YR 4/3) coatings on faces of peds; about 5 percent coarse fragments; strongly acid; clear wavy boundary.

Bt3—24 to 38 inches; brown (7.5YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; few very fine roots; common distinct dark brown (7.5YR 4/2) clay films on faces of peds and bridging sand grains; about 10 percent coarse fragments; strongly acid; clear wavy boundary.

Bt4—38 to 48 inches; dark brown (7.5YR 4/2) gravelly clay loam, except for a few inches of sandy clay loam in the lower part; weak medium and coarse subangular blocky structure; friable; dark brown (7.5YR 4/2) clay films bridging sand grains; about 20 percent coarse fragments; medium acid; clear irregular boundary.

2C—48 to 60 inches; brown (10YR 5/3), stratified gravelly coarse sand and very gravelly coarse sand; single grained; loose; about 30 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 40 to 72 inches. The content of coarse fragments ranges from 0 to 10 percent in the upper part of the Bt horizon and from 10 to 35 percent in the lower part.

The Ap horizon has chroma of 2 or 3. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or sandy clay loam. The lower part has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly clay loam, sandy clay loam, or the gravelly analogs of those textures, but some pedons have a thin layer of silty clay loam. The 2C horizon has value of 4 or 5 and chroma of 3 or 4. It is sand, loamy coarse sand, or the gravelly or very gravelly analogs of those textures.

Olentangy Series

The Olentangy series consists of deep, very poorly drained soils in depressions on lake plains and till plains. These soils formed in coprogenous earth and in the underlying lacustrine sediment or glacial till. Permeability is moderate in the solum and slow in the underlying material. Slope is 0 to 1 percent.

Olentangy soils commonly are adjacent to Linwood, Milford, and Pewamo soils. Linwood soils formed in organic material more than 16 inches thick. The mineral Milford and Pewamo soils have a mollic epipedon. They are in the slightly higher landscape positions along the margins of areas of the Olentangy soils.

Typical pedon of Olentangy silt loam, about 0.3 mile northeast of Huntersville, in Cessna Township; about 25 yards north and 273 yards east of the southwest corner of sec. 6, T. 4 S., R. 9 E.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few medium faint brown (10YR 4/3) mottles; moderate coarse and medium subangular blocky structure; firm; common medium and fine roots; neutral; clear wavy boundary.

A—11 to 21 inches; black (10YR 2/1) mucky silt loam; common coarse distinct dark grayish brown (10YR 4/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common medium and fine roots; strong brown (7.5YR 5/6) streaks of iron oxide; neutral; gradual wavy boundary.

Cg1—21 to 30 inches; dark grayish brown (10YR 4/2) mucky silt loam (coprogenous earth); common medium prominent strong brown (7.5YR 5/6) mottles; weak medium platy structure; friable; few very fine roots; several thin layers of small white (N 8/0) snail shells; mildly alkaline; gradual wavy boundary.

2Cg2—30 to 60 inches; gray (N 5/0) silt loam; few fine prominent strong brown (7.5YR 5/6) mottles;

massive; very friable; many small white (N 8/0) snail shells; strong effervescence; moderately alkaline.

The thickness of the coprogenous earth ranges from about 8 to 20 inches. Small aquatic shell fragments are in thin layers throughout the coprogenous earth.

The Ap horizon has value of 2 or 3 and chroma of 1 to 3. The Cg horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 3 to 5 and chroma of 1 or 2. The 2Cg 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 silt loam, silty clay loam, or clay loam.

Patton Series

The Patton series consists of deep, very poorly drained soils that formed in medium textured and moderately fine textured lacustrine sediment on lake plains. Permeability is moderately slow. Slope is 0 to 2 percent.

Patton soils are similar to Milford soils and commonly are adjacent to Del Rey, Milford, Pewamo, and Roundhead soils. Del Rey soils are somewhat poorly drained and are on slight rises. They have an ochric epipedon. Milford and Pewamo soils have more clay in the subsoil than the Patton soils. They are in landscape positions similar to those of the Patton soils. Roundhead soils have a histic epipedon and have free carbonates in the upper part of the subsoil. They are on the slightly lower parts of the lake plains.

Typical pedon of Patton silty clay loam, about 1.9 miles southwest of Dola, in Washington Township; about 385 yards south and 165 yards east of the northwest corner of sec. 21, T. 3 S., R. 10 E.

Ap—0 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; friable; common fine and medium roots; slightly acid; abrupt smooth boundary.

Bg1—11 to 18 inches; gray (5Y 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few fine roots; common distinct very dark gray (10YR 3/1) organic coatings on vertical faces of peds; common black (10YR 2/1) krotovinas; neutral; clear smooth boundary.

Bg2—18 to 26 inches; gray (5Y 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and common fine faint olive gray (5Y 5/2) mottles; weak medium and coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common black (10YR 2/1) krotovinas; neutral; gradual smooth boundary.

Bg3—26 to 37 inches; gray (5Y 5/1) silty clay loam; common medium prominent light olive gray (2.5Y 5/6) mottles; moderate medium subangular blocky structure; friable; few fine roots; common black (10YR 2/1) krotovinas; slight effervescence; mildly alkaline; gradual wavy boundary.

Cg1—37 to 52 inches; grayish brown (2.5Y 5/2) silt loam; common medium and coarse prominent yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

Cg2—52 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine and medium distinct gray (N 5/0) mottles; massive; weakly laminated; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 46 inches. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg and Cg horizons have hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 or 2. The Bg horizon is silty clay loam or silt loam.

Pewamo Series

The Pewamo series consists of deep, very poorly drained soils on till plains and lake plains. These soils formed mainly in moderately fine textured glacial till. In some areas, however, the upper part of the soils formed in lacustrine sediment. Permeability is moderately slow. Slope is 0 to 2 percent.

Pewamo soils commonly are adjacent to Blount, Glynwood, and Morley soils. The adjacent soils are better drained than the Pewamo soils and are on the higher or more sloping parts of the till plains.

Typical pedon of Pewamo silty clay loam, about 1.6 miles east of Ridgeway, in Hale Township; about 275 yards west of the intersection of County Road 240 and Township Road 197, along County Road 240, then 165 yards south:

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium granular structure; firm; many fine and medium roots; few coarse fragments; slightly acid; abrupt wavy boundary.

Btg1—11 to 14 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; many fine and medium roots; common faint dark gray (10YR 4/1) clay films on vertical faces of peds; common yellowish brown (10YR 5/8) stains of iron and manganese oxide; few coarse fragments; neutral; clear wavy boundary.

Btg2—14 to 19 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; common fine and medium roots; common faint gray (10YR 5/1) clay films on faces of peds; few very dark gray (10YR 3/1) krotovinas; few coarse fragments; neutral; gradual smooth boundary.

Btg3—19 to 26 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; few fine and medium roots; common faint gray (10YR 5/1) clay films on faces of peds; few dark gray (10YR 4/1) krotovinas; few coarse fragments; neutral; gradual smooth boundary.

BCg—26 to 33 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; common faint gray (10YR 5/1) coatings on vertical faces of peds; few dark gray (10YR 4/1) krotovinas; few coarse fragments; few accumulations of calcium carbonate; weak effervescence in spots; neutral; gradual wavy boundary.

Cg—33 to 60 inches; gray (10YR 5/1) clay loam; common medium and coarse distinct yellowish brown (10YR 5/6) mottles; massive; firm; few dark gray (10YR 4/1) krotovinas in the upper part; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 60 inches. The content of coarse fragments ranges from 0 to 5 percent in the upper part of the profile and from 0 to 10 percent in the underlying material.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Btg and Cg horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The Btg horizon is silty clay loam, silty clay, or clay loam. The Cg horizon is clay loam or silty clay loam.

Pewamo Variant

The Pewamo Variant consists of deep, very poorly drained soils that formed in a thin layer of organic material and in the underlying moderately fine textured glacial till. These soils are along the margins of former glacial lakes and marshes. Permeability is moderately slow or slow. Slope is 0 to 2 percent.

Pewamo Variant soils commonly are adjacent to Pewamo, McGuffey, and Roundhead soils. Pewamo soils have a mollic epipedon, have more clay in the subsoil than the Pewamo Variant soils, and have an argillic horizon. They are in the slightly higher landscape positions. McGuffey and Roundhead soils are in landscape positions similar to those of the Pewamo Variant soils. McGuffey soils have more clay in the control section than the Pewamo Variant soils, and Roundhead soils have a lower content of sand and coarse fragments throughout.

Typical pedon of Pewamo Variant muck, about 1.2 miles southwest of Foraker, in MacDonald Township; about 935 yards west of the intersection of County Road 110 and Township Road 85, along County Road 110, then 880 yards south:

Op—0 to 8 inches; black (10YR 2/1) muck, very dark gray (10YR 3/1) dry; moderate medium and fine granular structure; friable; common fine roots; neutral; abrupt wavy boundary.

Bg—8 to 14 inches; dark gray (5Y 4/1) clay loam; common medium distinct olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; few very fine roots; common distinct very dark gray (10YR 3/1) organic coatings on vertical faces of peds; common faint dark gray (5Y 4/1) coatings on vertical faces of peds; few white (10YR 8/1), weathered limestone fragments; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

BCg—14 to 21 inches; dark gray (5Y 4/1) clay loam; few medium prominent yellowish brown (10YR 5/6) and common coarse distinct olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; few very fine roots; few distinct very dark gray (10YR 3/1) coatings on vertical faces of peds; about 10 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—21 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; many medium distinct gray (5Y 5/1) mottles; massive; very firm; few very fine roots in the upper part; very few distinct very dark gray (10YR 3/1) and dark gray (10YR 4/1) coatings in partings; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 24 inches. The content of coarse fragments ranges from 0 to 15 percent throughout the mineral horizons.

The Op horizon has value of 2 or 3 and chroma of 1 or 2. The Bg and Cg horizons are clay loam or silty clay loam. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4.

Roundhead Series

The Roundhead series consists of deep, very poorly drained soils that formed in thin deposits of organic material and in the underlying medium textured and moderately fine textured lacustrine sediment. These soils are on lake plains and in marshes. Permeability is slow or moderately slow. Slope is 0 to 1 percent.

Roundhead soils commonly are adjacent to McGuffey, Milford, Patton, and Pewamo Variant soils. McGuffey soils have more clay in the subsoil and underlying material than the Roundhead soils. They are in landscape positions similar to those of the Roundhead soils. Milford and Patton soils are very poorly drained and are in the slightly higher positions on lake plains. They have a mollic epipedon. Pewamo Variant soils have a higher content of sand and coarse fragments in the mineral material than the Roundhead soils. They are along the margins of lake plains.

Typical pedon of Roundhead muck, about 2.5 miles south of McGuffey, in MacDonald Township; about 1,457 yards south of the intersection of State Route 195 and County Road 65, along County Road 65, then 55 yards east:

Op—0 to 10 inches; sapric material, black (10YR 2/1) broken face and rubbed, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; very friable; few fine roots; neutral; abrupt smooth boundary.

Bg1—10 to 16 inches; dark grayish brown (2.5Y 4/2) silt loam; common medium faint gray (5Y 5/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; few fine roots; black (10YR 2/1) wormcasts and common distinct organic coatings in vertical channels; common medium distinct white (10YR 8/1) aquatic shells; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg2—16 to 23 inches; grayish brown (2.5Y 5/2) silt loam; common medium faint light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; thin lenses of silt and very fine sand; common distinct yellowish brown (10YR 5/6) coatings of iron oxide in old root channels; common medium distinct light gray (10YR 7/2) gypsum crystals in old root channels; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg3—23 to 37 inches; gray (5Y 5/1) silty clay loam; common medium distinct olive brown (2.5Y 4/4) and dark grayish brown (2.5Y 4/2) mottles; weak medium and coarse subangular blocky structure; firm; common distinct yellowish brown (10YR 5/4) coatings of iron oxide in old root channels; common medium distinct light gray (10YR 7/2) gypsum crystals in old root channels; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg—37 to 60 inches; gray (5Y 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; weakly laminated; firm; strong effervescence; moderately alkaline.

The thickness of the histic epipedon ranges from 8 to 15 inches. It commonly is the same as the depth to free carbonates. The thickness of the solum ranges from 15 to 40 inches.

The Op horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. Some pedons have an Oa horizon, which is as much as 15 inches thick. The Bg and Cg horizons are dominantly silt loam or silty clay loam, but some pedons include thin strata of silty clay, clay loam, loam, or fine sandy loam. The Bg horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. The Cg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2.

Saranac Series

The Saranac series consists of deep, very poorly drained soils that formed in moderately fine textured alluvium on flood plains. Permeability is moderately slow. Slope is 0 to 2 percent.

Saranac soils are similar to Sloan soils and commonly are adjacent to Blount, Glynwood, Newark, and Nolin soils. Blount and Glynwood soils are better drained than the Saranac soils. They are on side slopes on uplands adjacent to flood plains. The somewhat poorly drained Newark soils and the well drained Nolin soils are in the slightly higher positions on the flood plains. They have more silt in the subsoil than the Saranac soils and have an ochric epipedon. Sloan soils have more silt and less clay in the subsoil than the Saranac soils.

Typical pedon of Saranac silty clay loam, occasionally flooded, about 0.3 mile east of Bridgeport, in Blanchard Township; about 28 yards west and 110 yards south of the northeast corner of sec. 33, T. 3 S., R. 11 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure parting to moderate fine and medium granular; friable; few fine roots; few coarse fragments; neutral; clear smooth boundary.

BA—10 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine distinct yellowish brown (10YR 5/4) and gray (N 5/0) mottles; moderate medium and fine subangular blocky structure; firm; few fine roots; few dark grayish brown (10YR 4/2) wormcasts; few dark grayish brown (2.5Y 4/2) krotovinas; many distinct very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; few coarse fragments; neutral; gradual wavy boundary.

Bg1—16 to 20 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct light olive brown (2.5Y 5/4) and common fine faint dark gray (N 4/0) mottles; moderate medium and fine subangular blocky structure; firm; few fine roots; few dark grayish brown (2.5Y 4/2) krotovinas; common distinct very dark grayish brown (2.5Y 3/2) coatings on faces of peds; few coarse fragments; neutral; gradual wavy boundary.

Bg2—20 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct light olive brown (2.5Y 5/4) and common fine faint dark gray (N 4/0) mottles; moderate medium and fine subangular blocky structure; firm; few fine roots; few dark grayish brown (2.5Y 4/2) krotovinas; common distinct very dark grayish brown (2.5Y 3/2) coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; neutral; gradual wavy boundary.

BCg—29 to 44 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct light olive brown (2.5Y 5/6) and few fine distinct dark gray (N 4/0) mottles; weak medium and coarse subangular blocky structure; firm; few fine roots; few distinct very dark grayish brown (2.5Y 3/2) coatings on faces of peds; few very dark gray (10YR 3/1) stains of iron and manganese oxide; few coarse fragments; neutral; gradual wavy boundary.

C—44 to 60 inches; olive brown (2.5Y 4/4) silty clay loam that has strata of silt loam; common medium and coarse prominent brownish yellow (10YR 6/8) and common medium distinct gray (N 6/0) mottles; massive; firm; few coarse fragments; few very dark gray (10YR 3/1) stains of iron and manganese oxide; mildly alkaline.

The thickness of the solum ranges from 20 to 48 inches. The depth to carbonates ranges from 40 to more than 60 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or silty clay. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 4. In some pedons it has strata of loam.

Shinrock Series

The Shinrock series consists of deep, moderately well drained soils that formed in moderately fine textured lacustrine sediment on lake plains. Permeability is moderately slow. Slope is 2 to 6 percent.

Shinrock soils are similar to Glynwood soils and commonly are adjacent to Del Rey and Fulton soils. Del Rey and Fulton soils are somewhat poorly drained. They are on slight rises, on low knolls, and along drainageways. Glynwood soils have coarse fragments throughout.

Typical pedon of Shinrock silt loam, 2 to 6 percent slopes, about 0.8 mile southeast of Patterson, in Jackson Township; about 117 yards east and 227 yards north of the southwest corner of sec. 17, T. 3 S., R. 12 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium and fine granular structure; friable; common fine and very fine roots; neutral; clear wavy boundary.

Bt1—8 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; few medium faint yellowish brown (10YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; moderate medium and fine angular blocky structure; firm; few fine and very fine roots; few faint brown (10YR 4/3) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—16 to 20 inches; olive brown (2.5Y 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; few fine and very fine roots; few faint brown (10YR 5/3) clay films on faces of peds; common distinct grayish brown (10YR 5/2) silt coatings on faces of peds; neutral; gradual wavy boundary.

BC—20 to 35 inches; light olive brown (2.5Y 5/4) silty clay loam stratified with silt loam; common medium distinct gray (10YR 5/1) and common medium faint light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to moderate coarse and medium subangular blocky; very firm; few very fine roots; many distinct gray (10YR 5/1) silt coatings on faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; few light gray (10YR 7/2) nodules of calcium carbonate; slight effervescence; mildly alkaline; gradual wavy boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; common medium faint light olive brown (2.5Y 5/6) and gray (10YR 6/2) mottles; very firm;

common distinct light gray (10YR 7/2) coatings of lime in vertical partings; common white (10YR 8/2) nodules of calcium carbonate; 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 chroma of 2 or 3. The Bt horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 4 or 5, and chroma of 4 to 6. It is silty clay loam, silty clay, clay, 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 dominantly silty clay loam or silt loam, but some pedons have thin strata of silty clay, silt, fine sandy loam, or very fine sand.

Sleeth Series

The Sleeth series consists of deep, somewhat poorly drained soils that formed in loamy outwash and in the underlying sandy and gravelly glacial outwash. These soils are on stream terraces and outwash plains. Permeability is moderate in the solum and very rapid in the underlying material. Slope is 0 to 3 percent.

Sleeth soils commonly are adjacent to Ockley and Westland soils. Ockley soils are well drained and are on slight rises, low knolls, and ridges. Westland soils are very poorly drained and are on flats, along drainageways, and in depressions. They have a mollic epipedon.

Typical pedon of Sleeth silt loam, 0 to 3 percent slopes, about 2.1 miles west of Kenton, in Buck Township; about 850 yards east of the intersection of Township Road 135 and County Road 130, then 330 yards north:

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; common fine and medium roots; few coarse fragments; slightly acid; clear wavy boundary.

BE—9 to 14 inches; yellowish brown (10YR 5/4) silty clay loam that has brownish gray (10YR 6/2) coatings on faces of peds; few medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) mottles; moderate medium and fine subangular blocky structure; friable; common fine and medium roots; few faint grayish brown (10YR 5/2) and brown (10YR 5/3) clay films on faces of peds; few dark grayish brown (10YR 4/2) organic coatings in root channels; few black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; neutral; gradual wavy boundary.

Bt1—14 to 19 inches; yellowish brown (10YR 5/4) silty clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; many medium faint yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; firm; common medium and fine roots; common faint grayish brown (10YR 5/2) clay films on faces of peds; few dark grayish brown (10YR 4/2) organic coatings in old root channels; very few distinct light brownish gray (10YR 6/2) silt coatings on vertical faces of peds; few black (10YR 2/1) stains of iron and manganese oxide; few coarse fragments; neutral; gradual wavy boundary.

2Bt2—19 to 32 inches; brown (10YR 5/3) clay loam that has grayish brown (10YR 5/2) coatings on faces of peds; common medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few medium and fine roots; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few black (2/1) stains of iron and manganese oxide; about 5 percent coarse fragments; neutral; gradual wavy boundary.

2Bt3—32 to 39 inches; brown (10YR 5/3) clay loam that has strata of sandy clay loam and has grayish brown (10YR 5/2) coatings on faces of peds; common medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak medium and coarse subangular blocky structure; firm; few fine and medium roots; few faint grayish brown (10YR 5/2) clay films on faces of peds and clay bridges in ped interiors; few coarse fragments; slightly acid; clear wavy boundary.

2BCg—39 to 49 inches; dark grayish brown (10YR 4/2) clay loam in the upper part and a few inches of sandy clay loam in the lower part; few fine and medium distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; friable; common faint dark brown (10YR 3/3) clay bridges in ped interiors; about 5 percent coarse fragments; mildly alkaline; abrupt wavy boundary.

2Cg—49 to 60 inches; grayish brown (10YR 5/2) and dark gray (10YR 4/1) gravelly sand that has thin strata of sand; single grained; loose; about 15 percent coarse fragments; weak effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. It commonly is the same as the depth to carbonates.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The Bt horizon has value of 4 to 6 and chroma of 1 to 4. It is silt loam or silty clay loam. The 2Bt and 2BCg horizons have value of 4 or 5 and chroma of 1 to 4. They are clay loam, sandy clay loam, loam, or the gravelly analogs of those textures. The 2Cg horizon has value of 4 or 5 and chroma of 1 or 2. It is gravelly loamy coarse sand, gravelly coarse sand, or gravelly sand.

Sloan Series

The Sloan series consists of deep, very poorly drained soils that formed in loamy alluvium on flood plains. Permeability is moderate or moderately slow. Slope is 0 to 2 percent.

The Sloan soils in Hardin County have a surface layer that is slightly lighter in color than is defined as the range for the series. This difference, however, does not alter the use or behavior of the soils.

Sloan soils are similar to Saranac soils and commonly are adjacent to Blount, Eel, Glynwood, and Newark soils. Blount and Glynwood soils are better drained than the Sloan soils and are on side slopes on uplands adjacent to flood plains. The moderately well drained Eel soils and the somewhat poorly drained Newark soils are in the higher positions on the flood plains. Saranac soils have more clay in the subsoil than the Sloan soils.

Typical pedon of Sloan silt loam, frequently flooded, about 0.7 mile northwest of Patterson, in Jackson Township; about 83 yards north and 220 yards east of the southwest corner of sec. 7, T. 3 S., R. 12 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; friable; many fine and medium roots; few coarse fragments; slightly acid; clear smooth boundary.

Bg1—9 to 15 inches; dark gray (10YR 4/1) silt loam; common medium distinct yellowish brown (10YR 5/6) and common fine distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; friable; common fine and medium roots; few faint very dark grayish brown (10YR 3/2) organic coatings on vertical faces of peds; few coarse fragments; neutral; gradual smooth boundary.

Bg2—15 to 22 inches; dark gray (10YR 4/1) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine and medium roots; few distinct very dark grayish brown (10YR 3/2) organic coatings on vertical faces of peds; common dark brown (7.5YR 3/2) stains of iron and manganese oxide; few coarse fragments; neutral; clear smooth boundary.

Bg3—22 to 36 inches; gray (10YR 5/1) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common dark brown (7.5YR 3/2) stains of iron and manganese oxide; few coarse fragments; neutral; gradual smooth boundary.

BCg—36 to 43 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots; common very dark grayish brown (10YR 3/2) stains of iron and manganese oxide; about 5 percent coarse fragments; neutral; gradual smooth boundary.

Cg—43 to 60 inches; gray (10YR 5/1) clay loam; common medium and coarse yellowish brown (10YR 5/6) mottles; massive; firm; common very dark grayish brown (10YR 3/2) stains of iron and manganese oxide; about 5 percent coarse fragments; neutral.

The thickness of the solum ranges from 25 to 55 inches. The content of coarse fragments ranges from 0 to 5 percent in the B horizon and from 0 to 15 percent in the C horizon.

The Ap horizon has chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, silt loam, silty clay loam, or loam. The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam, silt loam, clay loam, loam, sandy loam, or the gravelly analogs of those textures.

Wallkill Series

The Wallkill series consists of deep, very poorly drained soils that formed in silty alluvium and in the underlying organic plant material. These soils are on flood plains. Permeability is moderate in the mineral material and moderately rapid or rapid in the organic material. Slope is 0 to 2 percent.

The Wallkill soils in Hardin County have a thicker dark surface layer than is defined as the range for the series and have more silt in the overlying mineral material. These differences, however, do not alter the use or behavior of the soils.

Wallkill soils commonly are adjacent to Carlisle and Milford soils. Carlisle soils are organic throughout. They are in bogs. Milford soils have more clay in the subsoil and underlying material than the Wallkill soils. They are around the margins of lake plains.

Typical pedon of Wallkill silt loam, frequently flooded, about 1.25 miles north of Roundhead, in Roundhead Township; about 688 yards north and 275 yards west of the southeast corner of sec. 28, T. 5 S., R. 9 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; common fine and medium roots; slightly acid; gradual smooth boundary.

BA—11 to 16 inches; very dark gray (10YR 3/1) silt loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; few fine and medium roots; slightly acid; clear smooth boundary.

Bg—16 to 25 inches; very dark grayish brown (10YR 3/2) silt loam; many fine and medium prominent reddish yellow (5YR 7/8) and few fine distinct yellowish brown (10YR 5/4) mottles; weak fine and medium subangular blocky structure; friable; few fine roots; medium acid; abrupt smooth boundary.

2Oa1—25 to 29 inches; sapric material, black (10YR 2/1) broken face and rubbed; about 10 percent fiber, 0 percent rubbed; weak medium subangular blocky structure; friable; few very fine roots; strongly acid; clear smooth boundary.

2Oa2—29 to 36 inches; sapric material, dark reddish brown (5YR 2/2) broken face and rubbed; about 15 percent fiber, 3 percent rubbed; weak coarse subangular blocky structure; friable; medium acid; gradual smooth boundary.

2Oa3—36 to 60 inches; sapric material, dark reddish brown (5YR 3/2) broken face and rubbed; about 20 percent fiber, 7 percent rubbed; massive; friable; slightly acid.

The thickness of the mineral material ranges from 16 to 40 inches. The Ap horizon has value of 2 to 4 and chroma of 1 or 2. The Bg horizon has value of 3 to 5 and chroma of 1 or 2. It is silt loam or silty clay loam. The 2O horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly sapric material, but some pedons have thin layers of hemic material.

Westland Series

The Westland series consists of deep, very poorly drained soils that formed in loamy material over sandy and gravelly glacial outwash deposits. These soils are on stream terraces and outwash plains. Permeability is moderate in the solum and very rapid in the underlying material. Slope is 0 to 2 percent.

Westland soils are similar to Colwood soils and commonly are adjacent to Fox and Sleeth soils. Colwood soils have more silt and less gravel in the subsoil and underlying material than the Westland soils. Fox and Sleeth soils are better drained than the Westland soils and are on the slightly higher or more sloping parts of the landscape.

Typical pedon of Westland clay loam, about 1.6 miles southeast of Yelverton, in Taylor Creek Township; about 2,010 yards west of the intersection of U.S. Route 68 and Township Road 220, along Township Road 220, then 505 yards south:

Ap—0 to 12 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate fine and medium granular structure; friable; few medium roots; few coarse fragments; medium acid; gradual smooth boundary.

Btg1—12 to 19 inches; dark gray (10YR 4/1) clay loam; common medium distinct olive brown (2.5Y 4/4) and many medium distinct dark grayish brown (2.5Y 4/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few distinct dark grayish brown (2.5Y 4/2) clay films in pores and on faces of peds; few very dark gray (10YR 3/1) krotovinas; few coarse fragments; slightly acid; clear wavy boundary.

Btg2—19 to 30 inches; dark grayish brown (2.5Y 4/2) clay loam; many coarse prominent dark gray (N 4/0) and many medium distinct olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (2.5Y 4/2) clay films in pores and on faces of peds; few very dark gray (10YR 3/1) krotovinas; about 5 percent coarse fragments; neutral; clear wavy boundary.

Btg3—30 to 38 inches; dark grayish brown (2.5Y 4/2) clay loam; many coarse distinct light olive brown (2.5Y 5/4) and many coarse prominent dark gray (N 4/0) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (2.5Y 4/2) clay films in pores and on faces of peds; common very dark gray (10YR 3/1) krotovinas; about 5 percent coarse fragments; neutral; clear wavy boundary.

BCg—38 to 47 inches; dark gray (10YR 4/1) loam; few medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; friable; few fine roots; few distinct dark grayish brown (10YR 4/2) clay films on vertical faces of peds; few prominent very dark gray (10YR 3/1) krotovinas; about 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

2C—47 to 80 inches; brown (10YR 5/3) very gravelly loamy coarse sand; common fine distinct yellowish brown (10YR 5/6) mottles; single grained; loose; thin strata of loamy sand and loam in the upper part; about 40 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches. The content of gravel ranges from 0 to 5 percent in the upper part of the Btg horizon and from 0 to 15 percent in the lower part. It ranges from 15 to 50 percent in the underlying material.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Btg horizon has value of 4 or 5 and chroma of 1 or 2. It is clay loam or loam in the upper part and clay loam, loam, or sandy clay loam in the lower part. The 2C or 2Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is gravelly or very gravelly loamy sand or loamy coarse sand.

Formation of the Soils

This section relates the major factors of soil formation to the soils in Hardin County and explains some of the processes of soil formation.

Factors of Soil Formation

Soil is a three-dimensional natural body capable of supporting plants. The nature of the soil at a specific site is the result of the interaction of many factors and processes. The soil-forming factors are parent material, climate, living organisms, relief, and time.

Parent Material

The material in which a soil forms is called parent material. Most of the parent material in Hardin County was deposited by the last glacier that covered the survey area thousands of years ago or by meltwater from that glacier. The other kinds of parent material are the older dolomitic limestone bedrock residuum, the more recent alluvium deposited by recent streams, and organic deposits derived from decaying plants.

Glacial till was deposited directly beneath the glacial ice and was little acted upon by water. The till contains a variety of particles ranging from clay to large stones. Most pebbles are angular, indicating little water action. Although most of the material in the till is of local origin, some igneous stones were carried from parts of Canada. The glacial till at the surface was deposited during the Wisconsinan Glaciation.

The till plains in the county are divided into ground moraines and end moraines. The deposits on ground moraines are massive and compact. They are silty clay loam or clay loam. Variations in the content of clay and sand appear to be related to readvances of the glacier into local lacustrine deposits. Blount, Glynwood, Morley, and Pewamo soils formed in glacial till.

Meltwater deposits were laid down by water from the melting glacier. Gravel and sand were deposited in fast-moving streams. Fox, Ockley, Sleeth, and Westland soils formed in loamy material and in the underlying sandy and gravelly deposits on glacial stream terraces and in outwash areas. As the stream gradient became more nearly level, silt particles were deposited as deltas and bars and in local lake basins. Colwood, Kibbie, Martinsville, and Patton soils formed in sandy, loamy, and silty sediment in these areas. Where the streams flowed into local lakes, the finer particles settled out of the still water.

Clayey lacustrine deposits are extensive in Hardin County. They are in basins that were formed by the melting glacier. Del Rey, Fulton, Latty, Milford, and Montgomery soils formed in clayey sediment in the basins of former glacial lakes.

Dolomitic limestone underlies the glacial till in the Blount soils that have a limestone substratum and in Millsdale and Milton soils. The dolomitic limestone has a very high calcium carbonate equivalent. It is not violently effervescent, however, because of a high content of magnesium in the rock formation.

Alluvium is the parent material of the soils on flood plains. It accumulates when fresh sediment is added by stream overflow. The deposits vary widely, depending on the stream gradient and the source of the sediment. Alluvial sediment is stratified because it is deposited in three basic stages. Gravel and stones are deposited on the streambed, sand is deposited as bars along the inner banks of meanders, and sand, silt, and clay are deposited during flooding. Eel, Newark, Nolin, Saranac, and Sloan soils formed in alluvium.

Carlisle soils and the upper part of Linwood and Roundhead soils formed in decayed plant material that accumulated in marshes. The permanent wetness in the marshes slowed decomposition and promoted the accumulation of organic matter *(12)*.

Climate

The climate in Hardin County is so uniform that it has not greatly differentiated the soils within the county. It has favored physical changes and chemical weathering in the parent material and the activity of living organisms.

The amount of precipitation received varies as a result of microclimatic differences. The amount of effective precipitation is reduced by runoff on moderately steep slopes and is increased by drainage into depressions. The amount of rainfall in the county has been adequate to leach from the upper part of the subsoil any carbonates that were in the parent material of the soils on uplands and terraces. Wetting and drying cycles have resulted in the translocation of clay minerals and the formation of soil structure.

The range in temperature has favored both physical changes and chemical weathering of the parent material. Freezing and thawing aided the formation of soil structure. Warm temperatures in summer favored chemical reactions that helped to weather primary minerals. Rainfall and temperature have been conducive to plant growth and the accumulation of organic matter in all of the soils in the county.

More information about the climate is available in the section "General Nature of the County."

Living Organisms

The vegetation under which a soil forms influences the color, structure, and content of organic matter in the soil. The surface layer of the soils that formed under trees generally is lighter in color than that of soils that formed under grasses because the grasses generally return more organic matter to the soils. The grasses also provide shelter for many burrowing animals that alter the structure and thickness of soil horizons. Earthworms, burrowing insects, and small animals are constantly mixing the soil, making it more porous to air and water and adding organic residue. Bacteria, fungi, and other micro-organisms contribute to the breakdown of organic residue. Generally, fungi are more active in acid soils and bacteria are more active in alkaline soils.

Three types of native plant communities are recognized as typical of the original vegetation in Hardin County. These are the beech forest community, the elm-ash swamp forest community, and the marsh and fen plant community. The dominant type is the beech forest community. Beech, sugar maple, red oak, white ash, white oak, and basswood are the most common species in areas of this community *(8)*, and Blount, Glynwood, and Morley are the dominant soils.

The elm-ash swamp forest community consists of American elm, black ash, red maple, pin oak, swamp white oak, and hickory. It is in areas of Patton, Pewamo, Montgomery, Latty, and other very poorly drained soils.

The marsh and fen plant community is in areas of the very poorly drained Carlisle, Roundhead, and McGuffey soils. This community consists of a wide variety of water-tolerant species. Shrubs are common, but trees are rare *(8)*.

Human activities also affect soil formation. Examples of these activities are cultivation, seeding, artificial drainage, irrigation, and cutting and filling. The accelerated erosion caused by clearing and cultivating sloping soils, such as Fox, Glynwood, and Morley soils, illustrates the impact of human activities on soil formation. Loss of surface soil and compaction of the subsoil affect runoff and plant growth. Drainage systems reduce the content of organic matter and affect the processes of soil formation. Large areas of Latty, Milford, and Pewamo soils have been drained by ditches and subsurface drains. Adding lime or fertilizer affects the long-term development of the soil.

Relief

Relief, along with parent material, affects the natural drainage of soils. It influences the amount of runoff and depth to the water table. Generally, steeper soils are better drained than nearly level soils. If the extent of drainage differs, different soils can form in the same kind of parent material. For example, both Glynwood and Pewamo soils formed in glacial till. The moderately well drained Glynwood soils are in high landscape positions and generally do not have a water table close to the surface. In contrast, the very poorly drained Pewamo soils are in low, nearly level areas and have a water table near or above the surface.

A drainage sequence, or soil catena, is a group of soils that formed in the same kind of parent material but differ in the extent of natural drainage. For example, the well drained Morley soils, the moderately well drained Glynwood soils, the somewhat poorly drained Blount soils, and the very poorly drained Pewamo soils make up a drainage sequence. All of these soils formed in silty clay loam and clay loam glacial till.

Time

The length of time that parent material has been exposed to the soil-forming processes affects the nature of the soil that forms. The youngest soils in Hardin County are those that formed in recent stream deposits, such as Eel and Nolin soils. The horizons in these soils are less distinct than those in the older soils.

The glacial deposits in Hardin County are of Wisconsinan age and are geologically young. Nevertheless, sufficient time has elapsed for the development of distinct horizons through the active forces of climate and of plant and animal life. In most of the soils that formed in these deposits, carbonates have been leached, structure has developed in the subsoil, and organic matter has accumulated in the surface layer.

Processes of Soil Formation

Soil forms through complex, continuing processes that can be grouped into four general categories—additions, removals, transfers, and alterations *(13)*. The accumulation of organic matter in mineral soils is an example of an addition. The addition of organic residue results in a dark surface layer. The upper part of the parent material originally was not darker than the lower part.

The loss of lime is an example of a removal. Lime has been removed from the upper 2 to 4 feet in many of the soils in Hardin County. Although the parent material was limy, water percolating through the soils has leached the lime from the upper part of the profile.

Water has carried most of the material that has been transferred during the formation of the soils in Hardin County. Clay has been transferred from the A and E horizons to the B horizon in many of the soils. The A and E horizons, especially the E horizon, have become a zone of eluviation, and the B horizon has become a zone of illuviation. Thin clay films are in pores and on the faces of peds in the B horizon of some soils. The clay has been transferred from the A and E horizons. The presence of clay films is an important criterion in soil classification.

An example of an alteration is the reduction and solution of ferrous iron. This process has taken place in the very poorly drained soils in the county. The reduction of iron, or gleying, is evident in Latty, Milford, and Patton soils. It is the result of a recurring water table. A gray soil color is evidence of gleying. Reduced iron is soluble. The iron in the soils in Hardin County, however, commonly has remained in the horizon where it originated or has settled in an underlying horizon. In some areas the iron can be reoxidized and segregated as yellowish brown mottles that are brighter than the surrounding soil. The alteration of iron results in mottles in soils that are not well drained.

Each of the four soil-forming processes has affected all of the soils in Hardin County to some degree. The accumulation of organic matter has been prominent in the formation of McGuffey and Roundhead soils. The removal of carbonates and the transfer of clay have been prominent in the formation of Glynwood and Ockley soils.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

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.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

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.

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.

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.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

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.

Histic epipedon. A thin organic horizon that is saturated at some period of the year unless the soil is artificially drained and that is at or near the surface of a mineral soil.

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:
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.
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.

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.

Ochric epipedon. A surface horizon of mineral soil material that is too light in color, too high in chroma, too low in content of organic carbon, or too thin to be a plaggen, mollic, umbric, anthropic, or histic epipedon or that is both hard and massive when dry.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Perimeter drain. A drain installed around a septic tank absorption field to lower the water table. Also called a curtain drain.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

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:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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 drawbar 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.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

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 underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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.