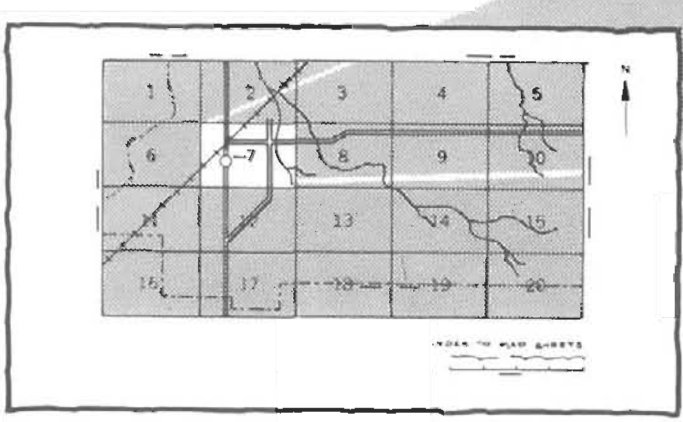
Soil Survey of

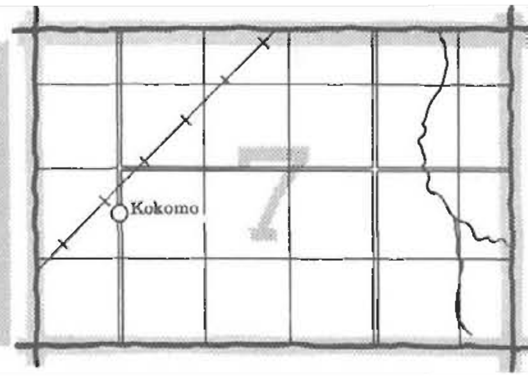
Auglaize County, Ohio

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

HOW TO US

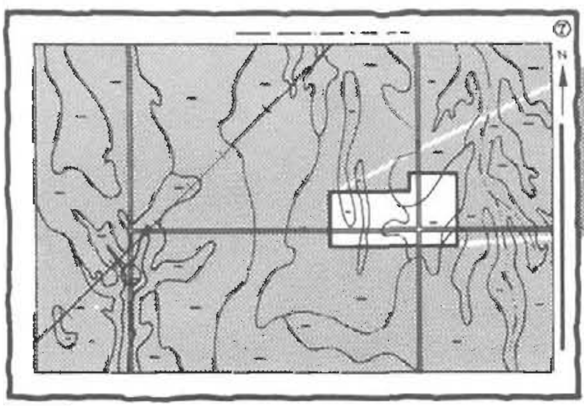
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

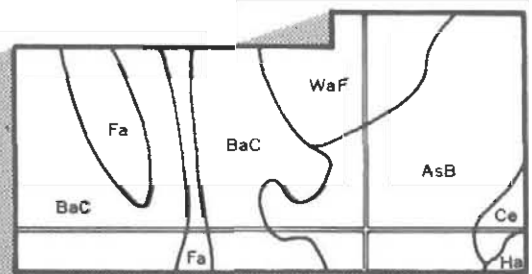




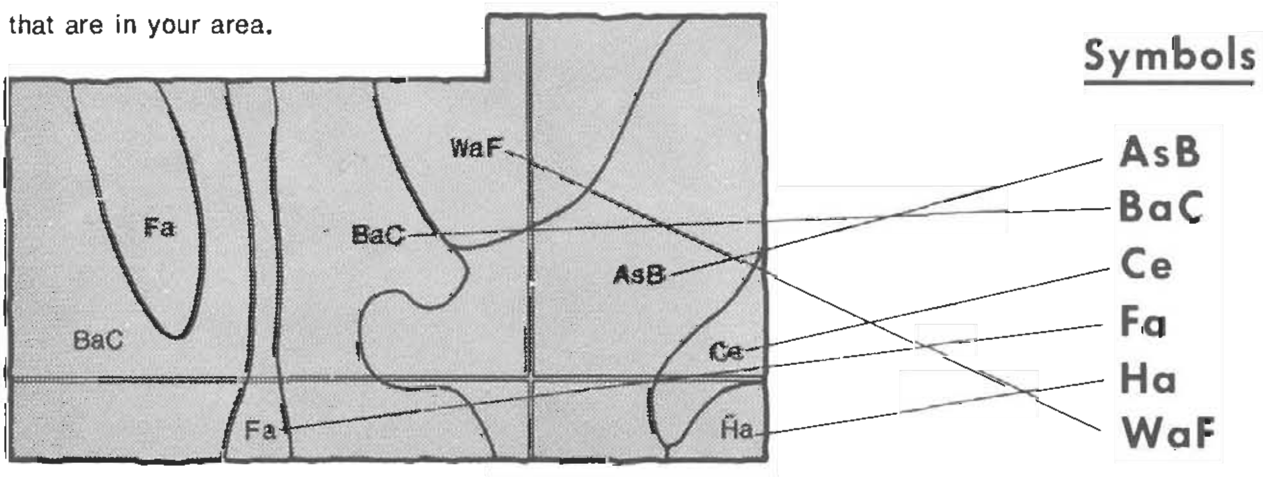
2. Note the number of the map sheet and turn to that sheet.

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



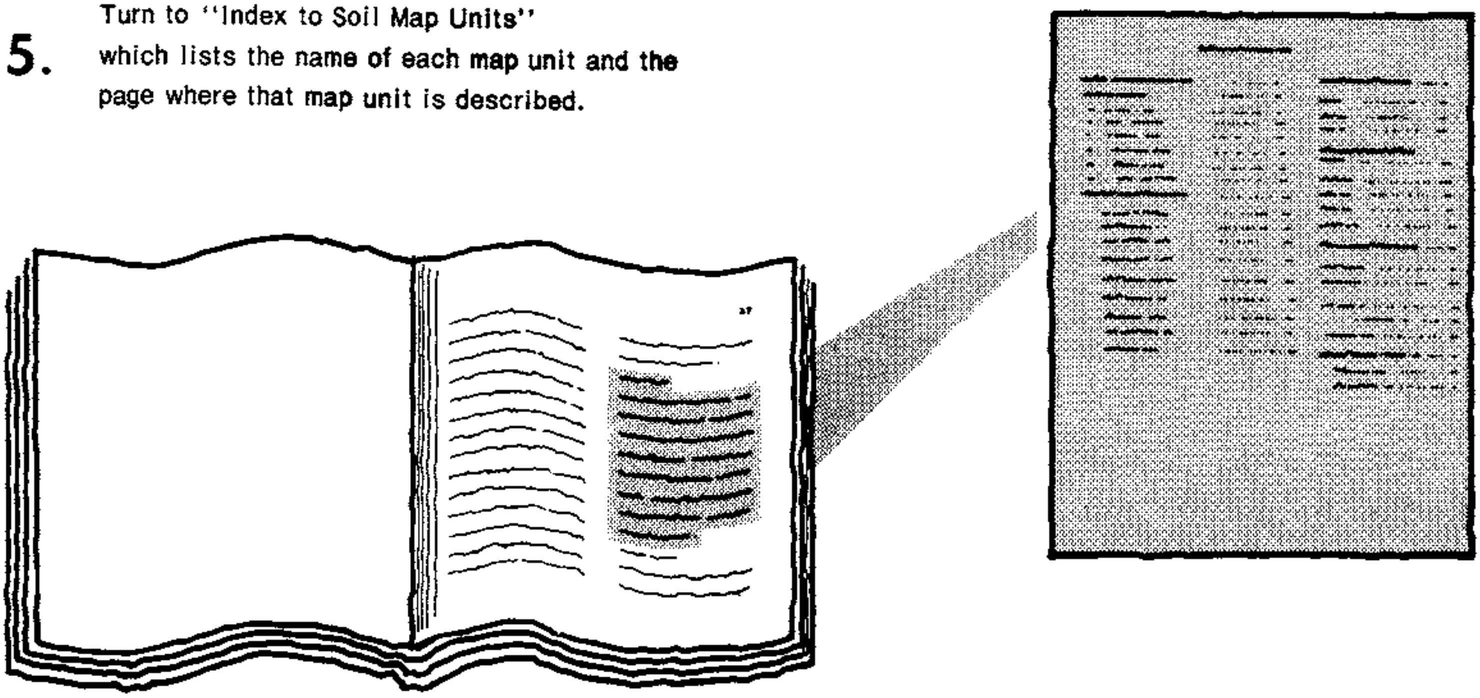


4. List the map unit symbols that are in your area.

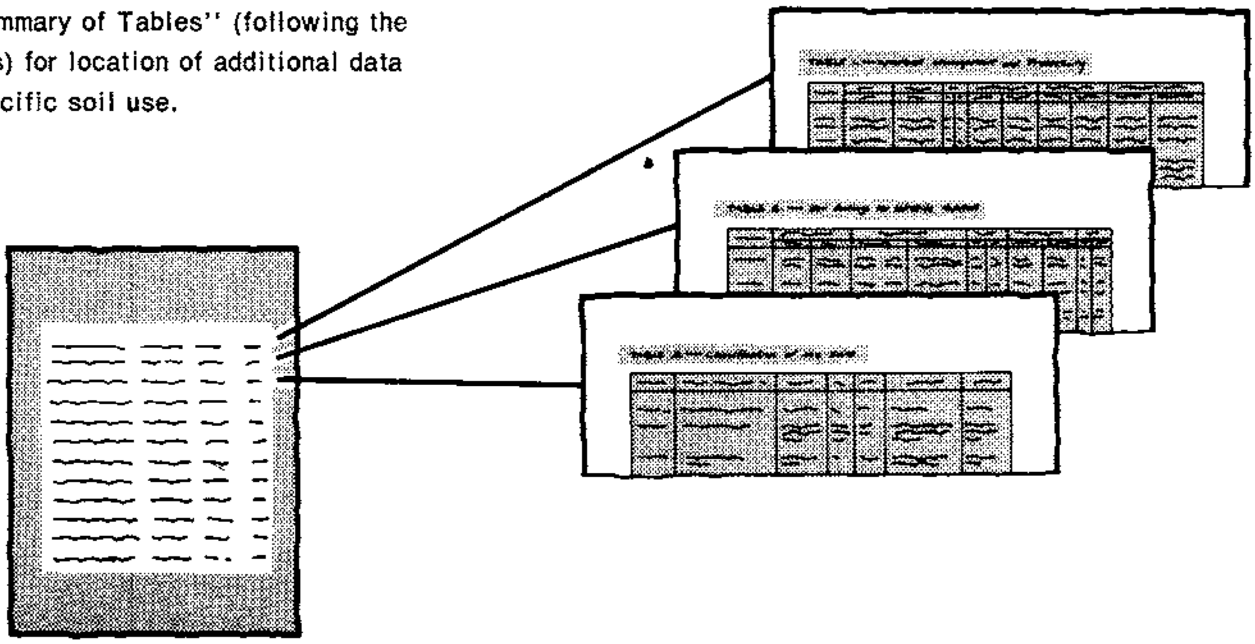


THIS SOIL SURVEY

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



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



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

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

This survey was made cooperatively by the Soil Conservation Service; the Ohio Department of Natural Resources, Division of Lands and Soil; and the Ohio Agricultural Research and Development Center. It was aided by funds provided by the Auglaize County Commissioners. The survey is part of the technical assistance furnished to the Auglaize Soil and Water Conservation District. Major fieldwork was performed in the period 1971-1978. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978.

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Issued December 1981

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foreword

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

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

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

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

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State Conservationist
Soil Conservation Service

soil survey of
Auglaize County, Ohio

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United States Department of Agriculture, Soil Conservation Service
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general nature of the county

AUGLAIZE COUNTY is in west-central Ohio (fig. 1). It occupies about 400 square miles, or 255,936 acres. In 1970, it had a population of 38,600. Wapakoneta, the county seat, and St. Marys are the largest towns.

Figure 1.—Location of Auglaize County in Ohio.

Auglaize County is one of the more important agricultural counties in Ohio. Cash grain farming dominated by corn and soybeans and livestock farming dominated by milk and beef production are the major farm enterprises. Poor natural drainage is the major soil limitation in the flatter areas. Erosion is the major hazard in sloping and moderately steep areas. Most of the soils can be highly productive if the more nearly level areas are adequately drained, if erosion is controlled in the sloping and moderately steep areas, and if all farmed areas are otherwise well managed.

Although Auglaize County is dominantly rural, nonfarm development, particularly residential development, is constantly taking place. This development is not on the scale that prevails in and near large metropolitan areas, but it is affected by many of the same soil limitations and hazards.

This survey updates the soil survey of Auglaize County published in 1910 (*10*). It provides additional information and larger maps, which show the soils in greater detail.

climate

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

Auglaize County is cold in winter and warm in summer. Winter precipitation, in the form of rain, snow, or sleet, results in a good accumulation of soil moisture by spring and minimizes drought during summer on most soils. Normal annual precipitation is adequate for all of the crops that are suited to the temperature and the length of the growing season.

Table 1 gives data on temperature and precipitation, as recorded at Celina, Ohio, in the period 1957 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 28 degrees F, and the average daily minimum temperature is 20 degrees. The lowest temperature on record, which occurred at Celina on January 16, 1972, is minus 19 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July 24, 1965, is 99 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 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, 20 inches, or 55 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 4.43 inches at Celina on September 17, 1969. Thunderstorms occur on about 41 days each year, and 20 of these days are in summer.

Average seasonal snowfall is 36 inches. The greatest snow depth at any one time during the period of record was 14 inches. On an average of 22 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 12 miles per hour, in March.

Tornadoes and severe thunderstorms occur occasionally. They are usually of local extent and of short duration, and the resulting damage varies from area to area.

physiography, relief, and drainage

Auglaize County is part of the Indiana and Ohio Till Plains, in the Central Lowland physiographic province. The highest elevation is about 1,100 feet above sea level, between Boundary Road and Wrestle Creek Road, in section 27 of Union Township. The lowest elevation is 800 feet above sea level where the St. Marys River leaves the county.

In much of the western two-thirds of the county, the soils are nearly level and gently sloping. Major changes in relief are evident only along streams and on the Fort Wayne, Wabash, and St. Johns moraines.

In the eastern third of the county, which is dominated by the St. Johns and Mississinewa moraines, stronger relief is evident. Most of the soils are gently sloping and sloping. The two major exceptions are a large lacustrine area and a large outwash basin. The lacustrine area is south of the St. Johns moraine and north of State Route 385. It extends from 2 miles northwest of New Hampshire in an easterly direction to the Auglaize-Hardin County line. The outwash basin is in the northeastern part of Clay Township, just south of the St. Johns and Beehive moraines. It extends westerly into a small lacustrine basin between the St. Johns and Mississinewa moraines at the headwaters of Pusheta Creek.

Blount and Pewamo soils are dominant in the nearly level and gently sloping areas, and Blount, Glynwood, and Morley soils are dominant in the gently sloping and sloping areas. Montgomery and Milford soils are dominant in the lacustrine areas and Millgrove and Digby soils in the outwash areas.

Auglaize County is a part of two continental watersheds. The Ohio-Erie Divide cuts through the county, generally along the central extension of the Mississinewa and St. Johns moraines. North and west of this divide, most of the water in the central part of the county is drained into Lake Erie by the Auglaize River and most in the western part by the St. Marys River. South of the Ohio-Erie Divide, the water is drained towards the Ohio River by several small tributaries. On a small acreage in the southwestern part of the county, water flows into Lake Loramie, which is part of the Great Miami River system. Most of the southeastern part of the county is drained by Willow and Muchinippi Creeks, which flow eastward into the Miami River. On a small acreage near the eastern boundary of the county, water drains into the Scioto River system through small drainage ditches.

Grand Lake is near the western boundary of the county. It is an artificially created body of water about 14,500 acres in size, a third of which is in Auglaize County. It provides water for the Ohio-Erie Canal system. The lake formed in a long, narrow swale that was dammed at each end. It drains from both ends, the west end into Beaver Creek and the east end into the St. Marys River.

geology

Auglaize County has been covered by continental glaciers at least three times. Wisconsin age glacial drift covers the entire county (*5*). Older glacial deposits are evident only in the deeply buried pre-Wisconsin age valley of the Teays River System. The Teays River entered what is now known as Auglaize County from the south in the area of New Knoxville and coursed northwestward, south of the city of St. Marys, into the area of Grand Lake (*7*). Part of the Teays Valley is a good source of ground water.

The Wisconsin age glacial drift includes till; outwash; loess, or silty windblown deposits; lacustrine deposits, or clayey and silty water-deposited material; and alluvium that was washed from these materials. The drift overlies limestone bedrock. Most of the limestone bedrock is of the Niagara Formation of the Silurian age, but in some areas in the northern part of the county, the younger limestone bedrock is of the Monroe Formation. The glacial drift is as much as several hundred feet thick in some areas and is a thin mantle in several areas in the northern part of the county.

The last glacier probably advanced from northwest to southeast across the county. Interstages of this glacier are revealed by the presence of end moraines, gently sloping and sloping landforms created by successive advances and retreats of the ice mass over a period of several thousand years (*6*). These moraines, from south to north, are the Mississinewa, the oldest; the St. Johns, the most pronounced in the county; the Beehive, a minor moraine in the eastern part of the county; the Wabash; and the Fort Wayne, the youngest. Between these end moraines, the glacial till was deposited more evenly and the moraine is called a ground moraine. During each retreat, melt water cut channels through the glacial till, creating the present drainage pattern.

Movement of the glacial ice over what is now Auglaize County enriched the glacial till with a high percent of limestone and dolomite pebbles and of ground-up limestone and dolomite. The glacial drift also contains numerous igneous rocks that were transported hundreds of miles from the north.

During warm, dry periods immediately after glaciation, winds blew fine silt-size particles, or loess, from the bare glacial drift, probably over an extensive area. As a result, Blount, Glynwood, and other soils, which formed mainly in glacial till, have a silty surface layer.

In some areas the melt water deposited outwash sand and gravel. In these areas the Digby, Eldean, Gallman, and Millgrove soils formed. On the St. Johns moraine, glacial rivers flowed through the ice, depositing various amounts of sand and gravel. Chunks of ice were buried in the glacial drift. The melting ice left rounded hills and potholes, or kettles. The kettles were filled with water and later became bogs as organic matter accumulated. Muskego and Carlisle soils formed in these organic deposits. Some of the more shallow depressions were filled with lake sediments. Montgomery soils formed in these sediments.

One glacial river flowed south through what is now the town of St. Johns, depositing large amounts of cobblestones, gravel, and sand in the moraine and on the south face of the moraine. This water flowed east into a large basin between the Mississinewa and St. Johns moraines and cut through the Mississinewa moraine at what is now State Route 65. It spread out and deposited fine gravel and sand at the western end of a second basin and sand and silt at the extreme eastern end. During the postglacial period this basin was under lake conditions. Silty and clayey sediments built up over the outwash material. The Millgrove, Digby Variant, and Eldean soils formed in this material.

A river flowing southeast from what is now Wapakoneta through Fryburg to the Shelby County line deposited sand and gravel. In the eastern part of the county, another river flowing under the ice deposited sand and gravel and finer material. After the ice melted, a north-south ridge was left at the present-day site of New Hampshire and State Route 196.

Some other areas in the county developed in lake conditions. The largest area is a depression between the St. Johns and Beehive moraines in the eastern part of the county. As the depression filled with melt water, a large, shallow lake formed. Silt and clay sediments settled to the bottom of the lake. Montgomery, Milford, and McGary soils formed in these deposits.

In the present stream valleys, more recent soil material has been deposited. This material is alluvium eroded from soils on uplands and terraces and deposited on flood plains. The Defiance, Genesee, Shoals, and Sloan soils formed in this material.

farming

About 90 percent of the total land area of Auglaize County is farmland, according to the 1974 Census of Agriculture. In 1977, the average size of the 1,720 farms was 145 acres (*13*).

In 1976, the cash receipts from crops were a little more than those from livestock and livestock products (*4*). The major commodities, ranked according to the percentage of total cash receipts in the county, were dairy, 22 percent; corn, 22 percent; soybeans, 21 percent; hogs, 11 percent; cattle, 11 percent; wheat, 7 percent; and all other, 6 percent.

In 1977, soybeans were grown on about 67,000 acres, corn on 52,200 acres, wheat on 32,000 acres, oats on 13,900 acres, and hay on 24,000 acres (*14*). The total number of livestock included 41,000 cattle and calves, 35,700 hogs and pigs, 9,600 milk cows and heifers, and 5,900 stock sheep.

how this survey was made

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

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

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

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

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

general soil map units

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

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

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

soil descriptions

soils on till plains, lake plains, and moraines

These soils make up about 84 percent of the county. They are very poorly drained or are somewhat poorly drained to well drained. They are nearly level to moderately steep soils on till plains, on broad flats on ground moraines and lake plains, and in hilly areas on end moraines. They formed in glacial till or in lacustrine sediments over glacial till.

These soils are used mainly for cash grain and livestock farming. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops. Seasonal wetness, slope, erosion, and moderately slow or slow permeability are the major limitations affecting most uses.

1. Blount-Pewamo association

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

This association is on broad flats on till plains. In most areas the flats are interspersed with drainageways and shallow depressions. The soils generally are nearly level and gently sloping but are sloping along drainageways.

This association makes up about 50 percent of the county. It is about 55 percent Blount soils, 25 percent Pewamo soils, and 20 percent soils of minor extent.

Blount soils are somewhat poorly drained, nearly level and gently sloping, and medium textured. They are on slight rises, low knolls, and foot slopes. Permeability is slow or moderately slow, and runoff is slow or medium. A seasonal high water table is between depths of 12 and 36 inches.

Pewamo soils are very poorly drained, nearly level, and medium textured and moderately fine textured. They are in depressions, along drainageways, and on broad flats. Permeability is moderately slow, and runoff is very slow or ponded. A seasonal high water table is near or above the surface.

Minor in this association are Glynwood soils on knolls and along drainageways; Montgomery, McGary, and Del Rey soils in old shallow glacial lakes; Haskins soils on very slight rises and low knolls on stream terraces and till plains; and Defiance, Shoals, and Sloan soils on flood plains.

In most areas the major soils are used for cash grain and livestock farming. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops. These soils have high potential for cultivated crops and for hay, pasture, and woodland. The potential is low for building site development and sanitary facilities and medium and low for most recreational uses.

The seasonal high water table in both of the major soils is the main limitation affecting most uses. Improving tilth in both of the soils and controlling erosion on the gently sloping Blount soils are additional concerns in farmed areas. A combination of subsurface and surface drains is commonly used to improve drainage. The slow or moderately slow permeability severely limits these soils as septic tank absorption fields. The Blount soils are better suited than the Pewamo soils as sites for buildings. Landscaping can keep surface water away from foundations. Local roads can be improved by installing a drainage system and by providing suitable base material.

2. Blount-Pewamo-Glynwood association

Nearly level and gently sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in glacial till

This association is on till plains and moraines. Most areas are dissected by drainageways. Most of the slopes are short. Some are complex.

This association makes up about 27 percent of the county. It is about 50 percent Blount soils, 20 percent Pewamo soils, 20 percent Glynwood soils, and 10 percent soils of minor extent.

Blount soils are somewhat poorly drained, nearly level and gently sloping, and medium textured. They are on slight rises, low knolls, and foot slopes. Permeability is slow or moderately slow, and runoff is slow or medium. A seasonal high water table is between depths of 12 and 36 inches.

Pewamo soils are very poorly drained, nearly level, and medium textured and moderately fine textured. They are in depressions and along drainageways. Permeability is moderately slow, and runoff is very slow or ponded. A seasonal high water table is near or above the surface.

Glynwood soils are moderately well drained, gently sloping, and medium textured. They are on knolls and along drainageways. Permeability is slow, and runoff is medium. A seasonal high water table is between depths of 24 and 42 inches.

Minor in this association are the sloping and moderately steep Morley soils on the sides of valleys and hills, Montgomery soils in narrow depressions, Eldean soils on stream terraces and end moraines, and Shoals and Sloan soils on flood plains.

In most areas the major soils are used for cash grain and livestock farming or for woodland. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops. These soils have high potential for cultivated crops, for hay and pasture, and for woodland. The potential is medium and low for building site development and sanitary facilities. The Glynwood soils have a higher potential for recreational uses than the other soils.

Wetness is the main limitation and erosion the main hazard affecting farm uses. Erosion is especially a hazard on the Glynwood soils because it is difficult to control on the short slopes. Surface and subsurface drains are commonly used in areas of the Pewamo and Blount soils to improve drainage. The Glynwood soils are better suited than the Pewamo and Blount soils as sites for buildings and sanitary facilities. The slow or moderately slow permeability and the wetness severely limit all of the major soils as septic tank absorption fields.

3. Blount-Pewamo-Del Rey association

Nearly level and gently sloping, somewhat poorly drained and very poorly drained soils formed in glacial till or in lacustrine sediments over glacial till

This association is on flats interspersed with drainageways and shallow depressions. It makes up about 2 percent of the county. It is about 40 percent Blount soils, 25 percent Pewamo soils, 20 percent Del Rey soils, and 15 percent soils of minor extent.

Blount soils are somewhat poorly drained, nearly level and gently sloping, and medium textured. They are on slight rises, low knolls, and foot slopes. Permeability is slow or moderately slow, and runoff is slow or medium. A seasonal high water table is between depths of 12 and 36 inches.

Pewamo soils are very poorly drained, nearly level, and medium textured and moderately fine textured. They are in depressions. Permeability is moderately slow, and runoff is very slow or ponded. A seasonal high water table is near or above the surface.

Del Rey soils are somewhat poorly drained, nearly level, and medium textured. They are on slight rises adjacent to broad lakebeds. Permeability and runoff are slow. A seasonal high water table is between depths of 12 and 36 inches.

Minor in this association are Glynwood soils on knolls and along drainageways, Montgomery and McGary soils in old shallow glacial lakes, and Haskins soils on slight rises and low knolls.

In most areas the major soils are used for cash grain and livestock farming. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops. These soils have high potential for cultivated crops and for hay and pasture. The potential is low for building site development and sanitary facilities and medium and low for most recreational uses.

The seasonal high water table in the major soils is the main limitation affecting most uses. Improving tilth in all of the major soils and controlling erosion on the Blount and Del Rey soils are additional concerns in farmed areas. A combination of subsurface and surface drains is commonly used to improve drainage. The slow or moderately slow permeability severely limits these soils as septic tank absorption fields. The higher positions on the landscape are the best building sites. Landscaping can keep surface water away from foundations. Local roads can be improved by installing a drainage system and by providing suitable base material.

4. Morley-Glynwood association

Gently sloping to moderately steep, well drained and moderately well drained soils formed in glacial till

This association is on ground and end moraines. Slopes generally are uneven.

This association makes up about 5 percent of the county. It is about 45 percent Morley soils, 40 percent Glynwood soils, and 15 percent soils of minor extent.

Glynwood soils are moderately well drained, gently sloping, and medium textured. They are on knolls and ridgetops. Permeability is slow, and runoff is medium. A seasonal high water table is between depths of 24 and 42 inches.

Morley soils are well drained, sloping and moderately steep, and moderately fine textured. They are on short slopes on the sides of hills and along streams. Permeability is slow, and runoff is rapid or very rapid.

Minor in this association are Montgomery and Pewamo soils along drainageways and in depressions; Blount and Del Rey soils on slight rises and knolls; and Eldean, Digby, and Haskins soils on the hummocky parts of end moraines.

In most areas the major soils are used for cash grain and livestock farming or for woodland. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops.

The Glynwood soils and the sloping Morley soils have a higher potential for most uses than the moderately steep Morley soils.

Erosion is the main hazard affecting most uses. It is especially a hazard if the sloping and moderately steep Morley soils are cultivated. The clay loam surface layer of the Morley soils puddles and crusts easily. Including grasses and legumes in the cropping system helps to control erosion and improves tilth. In a few areas slopes are long and smooth and can be farmed on the contour. A protective plant cover helps to control erosion during construction if the Morley soils are used as sites for buildings. The slope severely limits the Morley soils as sites for buildings. The slow permeability severely limits both of the major soils as septic tank absorption fields.

soils on glacial lake plains

These soils make up about 4 percent of the county. They are very poorly drained, fine textured soils on broad flats characterized by slight rises interspersed with drainage ditches. They formed in silty and clayey lake-laid deposits.

These soils are used mainly for cash grain farming. Corn and soybeans are the principal crops. Very poor natural drainage, ponding, slow or very slow permeability, a clayey surface layer, and a high shrink-swell potential in the subsoil are the main limitations affecting most uses.

5. Montgomery association

Nearly level, very poorly drained soils formed in lake-laid deposits

This association is on broad flats and slight rises in old shallow glacial lakes. Most areas are interspersed with drainage ditches.

This association makes up a little less than 3 percent of the county. It is about 75 percent Montgomery soils and 25 percent soils of minor extent.

Montgomery soils are fine textured. They are in depressions. Permeability is slow or very slow, and runoff is very slow or ponded. A seasonal high water table is near or above the surface.

Minor in this association are Pewamo soils in depressions in the transitional areas to the uplands; Latty soils on smooth flats and in shallow depressions; McGary, Del Rey, and Blount soils on slight rises and low knolls; Muskego and Carlisle soils in depressions; and Milford soils, which occur as areas intermingled with some areas of the Montgomery soils. The Milford soils contain less clay in the lower part of the subsoil and in the substratum than the Montgomery soils.

In most areas the major soils are used for cash grain farming. Corn and soybeans are the principal crops. These soils have high potential for cultivated crops, for hay and pasture, for woodland, and for wetland wildlife habitat. The potential is low for building site development, sanitary facilities, and recreational uses.

Very poor natural drainage, a clayey surface layer, ponding, slow or very slow permeability, and a high shrink-swell potential in the subsoil are the main limitations affecting most uses. Surface drains are used to remove excess surface water. Subsurface drains are used to remove free water from the subsoil. The soils can be tilled only within a narrow range of moisture content. Clods form and tilth deteriorates if the soils are tilled during wet periods, when they are soft and sticky. Properly designing the foundations of buildings helps to prevent the structural damage caused by shrinking and swelling. Local roads can be improved by installing a drainage system and by providing suitable base material. Undrained areas are well suited to habitat for wetland wildlife.

6. Milford association

Nearly level, very poorly drained soils formed in lake-laid deposits

This association is in a broad basin interspersed with drainage ditches. It makes up slightly more than 1 percent of the county. It is about 80 percent Milford soils and 20 percent soils of minor extent.

Milford soils are fine textured. They are on broad flats. Permeability is moderately slow. A seasonal high water table is near or above the surface.

Minor in this association are Montgomery soils, which occur as areas intermingled with areas of the Milford soils; McGary and Blount soils on slight rises; and Pewamo soils in depressions in the transitional areas to the uplands. The Montgomery soils contain more clay in the lower part of the subsoil and in the substratum than the Milford soils.

In most areas the major soils are used for cash grain farming. Corn and soybeans are the principal crops. These soils have high potential for cultivated crops and for hay and pasture. The potential is low for building site development, sanitary facilities, and recreational uses.

The very poor natural drainage and the clayey surface layer are the main limitations affecting farm uses. Surface drains are used to remove excess surface water. Subsurface drains are used to remove free water from the subsoil. The clayey surface layer can be tilled only within a narrow range of moisture content. Tilth deteriorates if the soils are tilled during wet periods. The major soils are poorly suited to building site development, sanitary facilities, and recreational uses because of the wetness, the ponding, the slow permeability, and the clayey surface layer. Local roads can be improved by installing a drainage system and by providing suitable base material. Undrained areas are well suited to habitat for wetland wildlife.

soils on stream terraces, outwash plains, and moraines

These soils make up about 6 percent of the county. They are very poorly drained or are somewhat poorly drained to well drained. They are nearly level to sloping soils on flats and in undulating and hummocky areas. They formed in glacial outwash, glacial till, and fine textured and moderately fine textured material over glacial outwash.

These soils are used mainly as cropland and woodland. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops. Droughtiness, seasonal wetness, erosion, and slow permeability are the main limitations affecting most uses.

7. Millgrove-Digby-Digby Variant association

Nearly level and gently sloping, very poorly drained and somewhat poorly drained soils formed in glacial outwash or in loamy material over glacial outwash

This association is on broad outwash plains and long, narrow to broad, low stream terraces. Most areas are characterized by slight rises and shallow depressions.

This association makes up about 4 percent of the county. It is about 55 percent Millgrove soils, 15 percent Digby soils, 10 percent Digby Variant soils, and 20 percent soils of minor extent.

Millgrove soils are very poorly drained, nearly level, and moderately fine textured. They are in the low lying areas on stream terraces and outwash plains. A seasonal high water table is near or above the surface. Permeability is moderate, and runoff is very slow or ponded.

Digby soils are somewhat poorly drained, nearly level and gently sloping, and medium textured. They are on rises and short slope breaks on stream terraces and outwash plains. A seasonal high water table is between depths of 12 and 30 inches. Permeability is moderate in the upper part of the subsoil and rapid in the lower part and in the substratum. Runoff is slow or medium.

Digby Variant soils are nearly level and somewhat poorly drained. They are on slightly elevated broad flats. A seasonal high water table is between depths of 12 and 30 inches. Permeability is slow in the upper part of the subsoil and rapid in the substratum. Runoff is slow.

Minor in this association are Gallman and Eldean soils on slope breaks and elevated broad flats; Haskins soils, which generally are in transitional areas to the uplands but also occur as areas intermingled with some areas of the major soils; Blount soils in the transitional areas to the uplands; and Muskego soils in the deeper depressions.

In most areas the major soils are used as cropland. Corn, soybeans, wheat, oats, and hay are the principal crops. These soils have high potential for cultivated crops and for hay, pasture, and woodland. The potential is low for building site development and sanitary facilities.

The major soils are well suited to cultivated crops and to pasture. Seasonal wetness is the main limitation affecting farm uses. Surface drains are commonly used to remove surface water on the nearly level soils. Subsurface drains are used to remove excess water from the root zone. Seasonal wetness and seepage severely limit all of the major soils as sites for buildings and sanitary facilities. Also, slow permeability severely limits the Digby Variant soils as septic tank absorption fields. The seepage can result in pollution of underground water supplies. Landscaping can keep surface water away from foundations.

8. Eldean-Glynwood association

Nearly level to sloping, well drained and moderately well drained soils formed in glacial outwash and glacial till

This association is on the hummocky parts of end moraines and on outwash plains. Most areas are undulating and gently rolling. Some are nearly level.

This association makes up about 2 percent of the county. It is about 60 percent Eldean soils, 30 percent Glynwood soils, and 10 percent soils of minor extent.

Eldean soils are well drained, nearly level to sloping, and medium textured. They are on flats and short slope breaks. They formed in glacial outwash. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is slow to rapid.

Glynwood soils are moderately well drained, gently sloping, and medium textured. They formed in glacial till. Permeability is slow, and runoff is medium. A seasonal high water table is between depths of 24 and 42 inches.

Minor in this association are the sloping and moderately steep Morley soils on the sides of valleys and hills; Digby, Del Rey, and Haskins soils on flats and slight rises; Montgomery and Pewamo soils along drainageways and in depressions; and some gravel pits. Some of the pits are filled with water.

In most areas the major soils are used as cropland and woodland. Corn, soybeans, wheat, oats, hay, and pasture are the principal crops. These soils have high or medium potential for cultivated crops and for building site development.

Erosion in the gently sloping and sloping areas of both of the major soils and droughtiness in the Eldean soils are the main concerns in managing cropland. Because of a limited available water capacity, the Eldean soils are better suited to early maturing crops than to crops that mature late in summer. The nearly level and gently sloping Eldean soils are better suited as sites for buildings than the sloping Eldean soils. The effluent from sanitary facilities can seep through the Eldean soils and pollute the underground water supplies.

soils on flood plains

These soils make up about 6 percent of the county. They are well drained, somewhat poorly drained, and very poorly drained, nearly level soils in long and narrow strips on flood plains. They are subject to flooding. They formed in recent alluvium.

Most areas of these soils are used for row crops, mainly corn and soybeans. Flooding, seasonal wetness, a clayey surface layer, and the slow or very slow permeability in the Defiance soils are the major limitations affecting most uses.

9. Shoals-Genesee-Sloan association

Nearly level, somewhat poorly drained, well drained, and very poorly drained soils formed in recent alluvium

This association is on long and narrow flats on flood plains along streams. The soils are subject to flooding.

This association makes up about 5 percent of the county. It is about 20 percent Shoals soils, 20 percent Genesee soils, 15 percent Sloan soils, and 45 percent soils of minor extent.

Shoals soils are somewhat poorly drained and are medium textured. They are on flats and in slight depressions near slope breaks to the uplands. They are occasionally flooded. A seasonal high water table is between depths of 12 and 36 inches. Permeability is moderate, and runoff is very slow.

Genesee soils are well drained and are medium textured. They are in the highest areas on the flood plains. They are occasionally flooded. Permeability is moderate, and runoff is slow.

Sloan soils are very poorly drained and are moderately fine textured. They are in depressions near slope breaks to the uplands. They are frequently flooded. A seasonal high water table is near or above the surface. Permeability is moderate or moderately slow, and runoff is very slow or ponded.

Minor in this association are Blount, Glynwood, and Morley soils in narrow strips on slope breaks to the uplands and Millgrove, Digby, and Digby Variant soils on low stream terraces.

In most areas the major soils are used for corn and soybeans. Some areas are used as pasture and woodland. These soils have high potential for cultivated crops and for woodland and low potential for building site development and sanitary facilities.

The flooding on all of the major soils and the seasonal wetness in the Shoals and Sloan soils are the chief limitations affecting most uses. These soils are suited to row crops that are grown year after year, such as corn and soybeans. In most years these crops can be planted and harvested during periods when the soils are not subject to flooding. Such crops as winter wheat can be severely damaged by floodwater A subsurface drainage system is needed in the Sloan and Shoals soils, but suitable outlets are not available in some areas. All of the major soils are generally unsuitable as sites for buildings and sanitary facilities because they are subject to flooding. Diking to control the flooding is difficult.

10. Defiance association

Nearly level, somewhat poorly drained soils formed in recent alluvium

This association is on long and narrow flats on flood plains along streams. The soils are frequently flooded.

This association makes up about 1 percent of the county. It is about 90 percent Defiance soils and 10 percent soils of minor extent.

Defiance soils are fine textured. Permeability and runoff are slow or very slow. A seasonal high water table is between depths of 12 and 30 inches.

Minor in this association are Shoals and Genesee soils, which occur as small areas intermingled with areas of the Defiance soils on flood plains; Gallman, Digby, and Haskins soils in narrow strips on stream terraces; and Glynwood and Morley soils in narrow strips on slope breaks to the uplands.

In most areas the major soils are used for cash grain farming. Some areas are used as pasture and woodland. These soils have high potential for cultivated crops. They have low potential for building site development, sanitary facilities, and most recreational uses.

The flooding, seasonal wetness, slow or very slow permeability, and clayey surface layer are the major limitations affecting most uses. These soils are suited to row crops that can be planted after the period of most spring flooding. Such crops as winter wheat can be severely damaged by floodwater. Subsurface drains are used in areas where suitable outlets are available. In many places, however, the outlets are submerged during periods of flooding. Timely tillage is important because the surface layer puddles and clods form if the soils are tilled when they are wet and sticky. The soils are generally unsuitable as sites for buildings and sanitary facilities because they are subject to flooding. Diking to control the flooding is difficult.

detailed soil map units

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

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

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, 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, Eldean loam, 2 to 6 percent slopes, is one of several phases in the Eldean series.

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. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

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

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

soil descriptions

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

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 24 inches thick. The upper part is mostly brown and dark grayish brown, mottled, firm silty clay, and the lower part is dark grayish brown, mottled, firm clay. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm clay loam. In places the soil contains virtually no coarse fragments throughout. In some areas the surface layer is loam.

Included with this soil in mapping are areas of the very poorly drained Pewamo soils in drainageways and depressions and small areas of the moderately well drained Glynwood soils on low knolls. Included soils make up less than 10 percent of most areas.

In the Blount soil a seasonal high water table is perched between depths of 12 and 36 inches in winter and in spring and other extended wet periods. Permeability is slow or moderately slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. The soil crusts easily after heavy rains. Runoff is slow. The shrink-swell potential is moderate. The upper part of the subsoil is very strongly acid to medium acid, and the lower part is neutral or mildly alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, hay, and pasture. Wetness and surface crusting are the main management concerns. Surface drains are used in many areas to remove excess surface water. Subsurface drainage systems are commonly used to lower the perched water table. Incorporating crop residue into the soil, planting cover crops, and applying barnyard manure help to prevent crusting. Soil compaction occurs if the soil is tilled, crops are harvested, or pasture is grazed during wet periods, when the soil is soft and sticky. Tillage and harvesting are best performed at optimum moisture levels and with the kind of equipment that minimizes soil compaction. Controlled grazing is needed in pastured areas.

This soil is suited to woodland. The species selected for planting should be those that can grow in a somewhat poorly drained soil that has a fine textured and moderately fine textured subsoil. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings and sanitary facilities. Also, the slow or moderately slow permeability is a severe limitation in septic tank absorption fields and low strength and frost action are severe limitations on sites for local roads. Landscaping can keep surface water away from the foundations. Drains around footings help to keep water away from basements. Local roads can be improved by installing a drainage system and by providing suitable base material.

The capability subclass is IIw; woodland suitability subclass 3c.

BoB—Blount silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on concave foot slopes and slightly convex low knolls on uplands. In some areas it occurs as a band between Glynwood soils on knolls and Pewamo soils in depressions. Most areas are long and narrow or irregularly shaped and range from 2 to 70 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 16 inches thick. The upper part is grayish brown, mottled, firm silty clay loam, and the lower part is brown and yellowish brown, mottled, firm clay. The substratum to a depth of about 60 inches is yellowish brown, firm clay loam. It is mottled in the upper part. In some areas the content of coarse fragments in the subsoil is 10 to 15 percent. In other areas the soil contains virtually no coarse fragments throughout.

Included with this soil in mapping are narrow areas of the very poorly drained Pewamo soils in drainageways and on some toe slopes, the moderately well drained Glynwood soils on the crests of knolls and on slope breaks along drainageways, and the well drained Eldean soils in hummocky areas. Included soils make up less than 10 percent of most areas.

In the Blount soil a seasonal high water table is perched between depths of 12 and 36 inches in winter and in spring. Permeability is slow or moderately slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. The soil crusts easily after heavy rains. Runoff is medium. The shrink-swell potential is moderate. The upper part of the subsoil is very strongly acid to medium acid, and the lower part is neutral or mildly alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, hay, and pasture. Erosion, wetness, and surface crusting are the main management concerns. Subsurface drainage systems are commonly used to lower the perched water table. Contour farming, a cropping system that includes sod or meadow crops, grassed waterways, and additions of a large amount of crop residue increase the infiltration rate, reduce the risk of erosion, and help to prevent surface crusting. Leaving crop residue on the surface in the fall and not plowing until spring also help to protect the soil against erosion.

Soil compaction occurs if this soil is tilled, crops are harvested, or pasture is grazed during wet periods, when the soil is soft and sticky. Tillage and harvesting are best performed at optimum moisture levels and with the kind of equipment that minimizes soil compaction. Controlled grazing is needed in pastured areas.

This soil is suited to woodland. The species selected for planting should be those that can grow in a somewhat poorly drained soil that has a fine textured and moderately fine textured subsoil. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for sanitary facilities. Also, the slow or moderately slow permeability is a severe limitation in septic tank absorption fields. Measures that divert runoff from the higher lying adjacent soils are needed on sites that are used for septic tank absorption fields.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings. Houses without basements are better suited than those with basements. Landscaping can keep surface water away from foundations. Drains around footings help to keep water away from basements. The included areas of the moderately well drained Glynwood soils are better sites for buildings than the Blount soil. Low strength and frost action are severe limitations on sites for local roads. Installing a drainage system and providing suitable base material improve the roads. This soil is a suitable site for ponds and lakes (fig. 2).

The capability subclass is IIe; woodland suitability subclass 3c.

Ca—Carlisle silty clay loam. This nearly level, very poorly drained organic soil is in depressions. Most areas are irregularly shaped and range from 5 to 60 acres in size.

Typically, the surface layer is very dark gray, mottled, firm silty clay loam about 12 inches thick. Below this to a depth of about 60 inches are layers of black and very dark gray, friable muck. In some areas the soil does not have a mineral surface layer. In other areas sandy loam is below a depth of about 50 inches.

A seasonal high water table is near or above the surface for long periods. Runoff is very slow.

Figure 2.—Lake in an area of Blount silt loam, 2 to 6 percent slopes. Lakes provide recreational opportunities and are a potential water supply for firefighting.

Permeability is moderately slow to moderately rapid. The root zone is deep and has a very high available water capacity. Reaction is medium acid to neutral. Organic matter content is high.

Most areas are used for corn, soybeans, and small grain. Undrained areas support native sedges and cattails. This soil has high potential for cultivated crops and for wetland wildlife habitat. The potential for building site development, sanitary facilities, and recreational uses is very low.

The very poor natural drainage and the ponding are the major limitations if this soil is used for crops. Surface drains are commonly used to remove the ponded water. Subsurface drains are also used in areas where outlets are available. Subsidence or shrinkage occurs as the result of oxidation of the organic material after the soil is drained. Controlled drainage in areas where the water table can be raised or lowered reduces the shrinkage. Drained areas are suited to the grasses grown for hay or pasture.

This soil is not well suited to woodland. Undrained areas can support water-tolerant trees and some cattails, reeds, or sedges. The windthrow hazard can be reduced by planting deep rooted species.

This soil is unsuitable as a site for buildings, local roads, sanitary facilities, and most recreational uses. Undrained areas provide habitat for ducks, muskrat, and other wetland wildlife.

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

Dc—Defiance silty clay, frequently flooded. This nearly level, somewhat poorly drained soil is on flood plains. It is commonly adjacent to streams, and it occupies the entire flood plain along some of the streams. Most areas are long and narrow.

Typically, the surface layer is dark grayish brown, firm silty clay about 8 inches thick. The subsoil is dark grayish brown, dark gray, and gray, mottled, firm and very firm silty clay about 42 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled, firm silty clay. In some areas the surface layer is silty clay loam. It is very dark grayish brown in other areas. The substratum is loam or gravelly sandy loam in places.

A seasonal high water table is between depths of 12 and 30 inches in winter and in spring and other extended wet periods. Permeability and runoff are slow or very slow. The root zone is deep and has a moderate available water capacity. Tilth is poor. The shrink-swell potential is moderate. The subsoil is neutral or mildly alkaline. Organic matter content is moderate.

Most of the acreage is used for cultivated crops. Some of the lower areas along streams or in oxbows are used as woodland or pasture. This soil has high potential for cultivated crops and high or medium potential for woodland. It has low potential for building site development, sanitary facilities, and most recreational uses.

This soil is suited to row crops that can be planted after the period of most spring flooding. It is not well suited to specialty crops because it dries slowly in spring and because flooding is a hazard. Winter crops and early spring crops, such as wheat and oats, are usually not grown. Subsurface drains are used in areas where suitable outlets are available. In many areas the outlets are submerged during periods of flooding. If cropped year after year, the soil becomes dense and compact. Returning a large amount of crop residue to the soil helps to prevent compaction. Timely tillage is important because the soil puddles and clods if worked when wet and sticky. Compaction can result if pasture is grazed during wet periods, when the soil is soft and sticky.

This soil is suited to some trees. The species selected for planting should be those that can grow in a somewhat poorly drained soil that has a fine textured surface layer. Plant competition can be controlled by spraying, mowing, or disking.

This soil is generally unsuitable as a site for buildings, local roads, sanitary facilities, and most recreational uses because it is subject to flooding. Diking to control the flooding is difficult.

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

DeA—Del Rey silt loam, till substratum, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil generally is on slight rises around broad lakebeds that are adjacent to gently rolling uplands. In a few scattered areas, it is in the lower positions on till plains. Most areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is mottled, firm silty clay loam about 33 inches thick. It is light brownish gray in the upper part, dark yellowish brown and brown in the next part, and dark grayish brown in the lower part. The upper 4 inches of the substratum is grayish brown, mottled, friable silt loam. The lower part to a depth of about 60 inches is brown, firm clay loam glacial till. In some areas the surface layer and subsoil are more silty.

Included with this soil in mapping are Pewamo soils in depressions in till plains and Montgomery soils in depressions in lakebeds. Also included are areas where the substratum is stratified silt loam, silty clay loam, fine sandy loam, and silty clay. Stability is poorer in these areas. Included soils make up about 20 percent of most areas.

In the Del Rey soil a seasonal high water table is between depths of 12 and 36 inches in winter and in spring and other extended wet periods. Permeability is slow. The root zone is moderately deep or deep to compact glacial till. Available water capacity is moderate or high. The soil crusts easily after heavy rains. Runoff is slow. The shrink-swell potential is moderate. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, pasture, and hay are the principal crops. This soil has high potential for cultivated crops and for pasture and woodland. It has low potential for building site development and sanitary facilities and medium or low potential for recreational uses.

This soil is suited to corn, soybeans, wheat, hay, and pasture. Wetness and surface crusting are the main management concerns. Surface drains are used in many areas to remove excess surface water. Subsurface drainage systems are commonly used to lower the seasonal high water table. Incorporating crop residue into the soil, planting cover crops, and applying barnyard manure help to prevent crusting. Soil compaction occurs if the soil is tilled, crops are harvested, or pasture is grazed during wet periods, when the soil is soft and sticky. Tillage and harvesting are best performed at optimum moisture levels and with the kind of equipment that minimizes soil compaction. Controlled grazing is needed in pastured areas.

This soil is suited to woodland and to habitat for openland and woodland wildlife. The trees that can tolerate some wetness should be selected for planting. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings or septic tank absorption fields. Also, the slow permeability is a severe limitation in septic tank absorption fields. Extending the base of foundations to the underlying glacial till results in better stability. Drains around footings help to keep water away from basements. Landscaping can keep surface water away from foundations. Low strength and frost action are severe limitations on sites for local roads. The roads can be improved by installing a drainage system and by providing suitable base material. The wetness, erodibility, and slow permeability limit the soil as a site for most recreational uses.

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

DmA—Digby loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on slightly elevated flats on stream terraces and outwash plains. Most areas are oval or irregularly shaped and range from 2 to 60 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 8 inches thick. The subsoil is about 29 inches thick. It is brown and mottled. The upper part is very friable loam, the next part is friable sandy clay loam, and the lower part is very friable gravelly coarse sandy loam. The substratum to a depth of about 60 inches is grayish brown, loose gravelly loamy coarse sand that has strata of gravelly sandy loam. Depth to the substratum is 48 to 80 inches in some areas. Available water capacity is higher in these areas, and the soil is not so droughty. In some areas moderately fine textured or fine textured glacial till or lacustrine material is in the substratum.

Included with this soil in mapping are small areas of the well drained Gallman soils on slight rises and narrow strips of the very poorly drained Millgrove soils in depressions. Also included are some areas where the surface layer is sandy loam, the hazard of soil blowing is more severe, and cultivation is easier. Included soils make up about 15 percent of most areas.

In the Digby soil a seasonal high water table is between depths of 12 and 30 inches in winter and in spring and other extended wet periods. Permeability is moderate in the upper part of the subsoil and rapid in the lower part and in the substratum. The root zone is deep and has a moderate available water capacity. Runoff is slow. The shrink-swell potential is low. The upper part of the subsoil is very strongly acid to slightly acid, and the lower part is slightly acid to moderately alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, oats, and pasture. Seasonal wetness is the main limitation. Surface drains are used to remove excess surface water. Subsurface drains are commonly used to lower the seasonal high water table. The soil is well suited to irrigation. Incorporating crop residue into the soil, planting cover crops, and applying barnyard manure increase organic matter content and improve tilth. Tillage and harvesting are best performed at optimum moisture levels and with the kind of equipment that minimizes soil compaction.

This soil is well suited to trees and to the plants that enhance habitat for openland and woodland wildlife. The species that can tolerate some wetness should be selected for planting. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings and sanitary facilities. Also, the effluent from sanitary facilities can seep into underground water supplies. Because of the rapidly permeable substratum, subsurface water can move into basements. Also, it causes difficulties during construction. Drainage ditches and subsurface drains can lower the seasonal high water table. Installing drains around footings and coating exterior basement walls help to keep moisture out of basements. Frost action is a severe limitation on sites for local roads. The roads can be improved by installing a drainage system and by providing suitable base material.

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

DmB—Digby loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil generally is on short slope breaks on outwash plains and near the base of the flanks of stream terraces. In a few areas it is on till plains. Most areas are oval or irregularly shaped and range from 3 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part is grayish brown, mottled, friable and firm clay loam; the next part is dark yellowish brown, mottled, firm clay loam; and the lower part is grayish brown, mottled, firm sandy clay loam. The substratum to a depth of about 60 inches is dark brown and grayish brown, mottled, loose gravelly loamy sand. Depth to the substratum is 48 to 80 inches in some areas. In these areas, available water capacity is higher and the soil is not so droughty. In places moderately fine textured or fine textured glacial till or lacustrine material is in the substratum.

Included with this soil in mapping are small areas of the well drained Gallman soils on the upper part of slopes and on low knolls. Also included are some areas where the surface layer is sandy loam, the hazard of soil blowing is more severe, and cultivation is easier. Included soils make up about 15 percent of most areas.

In the Digby soil a seasonal high water table is between depths of 12 and 30 inches in winter and in spring and other extended wet periods. Permeability is moderate in the upper part of the subsoil and rapid in the lower part and in the substratum. The root zone is deep and has a moderate available water capacity.

Runoff is slow or medium. The shrink-swell potential is low. The upper part of the subsoil is very strongly acid to slightly acid, and the lower part is slightly acid to moderately alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, oats, and pasture. Controlling erosion and reducing the wetness are the main management concerns. Including meadow crops in the cropping system and establishing grassed waterways reduce the risk of erosion, increase organic matter content, and improve tilth. Subsurface drains are commonly used to lower the seasonal high water table. Soil compaction occurs if the soil is tilled, crops are harvested, or pasture is grazed during wet periods, when the soil is soft and sticky. Controlled grazing is needed in pastured areas.

This soil is well suited to trees and to the plants that enhance habitat for openland and woodland wildlife. The species that can tolerate some wetness should be selected for planting. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings, sanitary facilities, or recreational development. Also, the effluent from sanitary facilities can seep into underground water supplies. Because of the rapidly permeable substratum, subsurface water can move into basements. Also, it causes difficulties during construction. Drainage ditches and subsurface drains can lower the seasonal high water table. Installing drains around footings and coating exterior basement walls help to keep moisture out of basements. Frost action is a severe limitation on sites for local roads. The roads can be improved by installing a drainage system and by providing suitable base material.

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

DoA—Digby Variant silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on slightly elevated broad flats. Most areas are irregularly shaped and range from 2 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 37 inches thick. The upper part is brown, mottled, firm clay loam; the next part is light brownish gray and brown, mottled, firm clay; and the lower part is yellowish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is grayish brown, mottled, loose loamy sand.

Included with this soil in mapping are small areas of the well drained Eldean soils on slight rises and narrow strips of the very poorly drained Millgrove soils in depressions. Included soils make up about 15 percent of most areas.

In the Digby Variant soil a seasonal high water table is between depths of 12 and 30 inches in winter and in spring and other extended wet periods. Permeability is slow in the upper part of the subsoil, and it is rapid in the substratum. The root zone is deep and has a moderate available water capacity. Runoff is slow. The shrink-swell potential is moderate in the upper part of the subsoil and low in the lower part and in the substratum. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral to moderately alkaline. Organic matter content is moderate.

Most areas are used for corn, soybeans, wheat, and oats. This soil has high potential for row crops, small grain, hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, oats, pasture, and specialty crops. Seasonal wetness is the main limitation. Surface drains are used to remove excess surface water. Subsurface drains are commonly used to lower the seasonal high water table. Incorporating crop residue into the soil, planting cover crops, and applying barnyard manure increase organic matter content and improve tilth. Tillage and harvesting are best performed at optimum moisture levels and with the kind of equipment that minimizes soil compaction.

This soil is well suited to trees and to the plants that enhance habitat for openland and woodland wildlife. The species selected for planting should be those that can grow in a somewhat poorly drained soil that is fine textured and moderately fine textured in the upper part of the subsoil. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings and sanitary facilities. Also, the slow permeability is a severe limitation in septic tank absorption fields. The effluent from sanitary facilities can seep into underground water supplies. Because of the rapidly permeable substratum, subsurface water can move into basements. Also, it causes difficulties during construction. Drainage ditches and subsurface drains can lower the seasonal high water table. Installing drains around footings and coating exterior basement walls help to keep moisture out of basements. Low strength and frost action are severe limitations on sites for local roads. The roads can be improved by installing a drainage system and by providing suitable base material.

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

EmB—Eldean loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on stream terraces and in outwash areas on end moraines. Most areas are long and narrow or oblong and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown and dark yellowish brown, firm clay loam, and the lower part is brown, friable gravelly clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, very friable very gravelly coarse sandy loam. In some areas slopes are 0 to 2 percent. In other areas more gravel is in the surface layer.

Included with this soil in mapping are small areas of Glynwood and Morley soils on end moraines and on slope breaks to the uplands. Included soils make up about 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. The root zone is mainly moderately deep and has a low or moderate available water capacity. Runoff is medium. The shrink-swell potential is moderate or low in the subsoil and low in the substratum. The upper part of the subsoil is strongly acid to neutral, and the lower part is neutral or mildly alkaline. Organic matter content is moderate.

Most areas are used as cropland. This soil has high potential for cropland, hay, woodland, building site development, and most recreational uses.

This soil is well suited to corn, soybeans, wheat, oats, hay, and pasture. Because of the limited available water capacity, it is better suited to early maturing crops than to crops that mature late in summer. It is well suited to irrigation. The principal management concern is erosion. Minimizing tillage, returning crop residue to the soil, and including sod crops in the cropping sequence reduce the risk of erosion, improve tilth, and increase the rate of water intake.

This soil is well suited to trees and to habitat for woodland and openland wildlife. Machine planting of tree seedlings is practical on this soil. Plant competition can be controlled by spraying, mowing, or disking.

This soil is well suited to building site development and recreational uses. The shrink-swell potential, however, is a moderate limitation on sites for most buildings, and the moderate or moderately slow permeability is a moderate limitation in many recreational areas. Low strength is a severe limitation on sites for local roads. The roads can be improved by replacing the subsoil with suitable base material. The effluent from sanitary facilities can seep into underground water supplies.

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

EmC—Eldean loam, 6 to 12 percent slopes. This sloping, well drained soil is on short slope breaks on stream terraces and in outwash areas on end moraines. Most areas are long and narrow, oval, or irregularly shaped. They are about 2 to 6 acres in size.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil is dark yellowish brown, firm clay loam about 26 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, friable gravelly coarse sandy loam. In some areas the surface layer is gravelly loam. In a few narrow strips on slope breaks, slopes are 12 to 18 percent.

Included with this soil in mapping are narrow strips where the soil is severely eroded, the surface layer is clay loam, and tilth is poor. This included soil makes up about 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. The root zone is mainly moderately deep and has a low available water capacity. Runoff is rapid. The shrink-swell potential is moderate or low in the subsoil and low in the substratum. The upper part of the subsoil is strongly acid to neutral, and the lower part is neutral or mildly alkaline. Organic matter content is moderately low.

Most areas are used as cropland. Some areas support shrubs and trees. The soil has medium potential for cropland and for building site development, sanitary facilities, and most recreational uses. It has high potential for woodland and pasture.

This soil is suited to cultivated crops and to hay and pasture. Because of the limited available water capacity, it is better suited to early maturing crops than to crops that mature late in summer. Conservation practices, such as contour tillage and diversion terraces, are not feasible in most areas because slopes are short. Including long term hay and pasture in the cropping system reduces the erosion hazard. Keeping tillage at a minimum and returning crop residue to the soil reduce the risk of erosion, improve tilth, and increase the infiltration rate.

This soil is well suited to trees and to habitat for woodland and openland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

Most areas are suitable as sites for buildings and sanitary facilities, however, the slope limits the use of this soil as a site for buildings or sewage lagoons. Also, the effluent from sanitary facilities can seep into underground water supplies. Low strength is a severe limitation on sites for local roads. The roads can be improved by replacing the subsoil with suitable base material. Runoff and erosion accelerate during construction. Maintaining a plant cover wherever possible reduces the runoff rate and helps to control erosion. Trails in recreational areas should be established across the slope and otherwise protected against erosion.

The capability subclass is IIIe; woodland suitability subclass 2o.

EnA—Eldean silt loam, 0 to 3 percent slopes. This nearly level, well drained soil is on broad flats on outwash plains. Most areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is dark brown and dark yellowish brown, firm silty clay loam; the next part is dark yellowish brown, firm clay; and the lower part is brown, firm sandy clay loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly loamy sand. In some areas the substratum is calcareous, loose sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Digby Variant and very poorly drained Millgrove soils in slight depressions. Included soils make up about 10 percent of most areas.

Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep to sand and gravel and has a low or moderate available water capacity. Organic matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is strongly acid to neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is cropland. This soil has high potential for cultivated crops and for hay, pasture, trees, building site development, and recreational uses.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Droughtiness is the main limitation on cropland. Crops can be planted early because the soil warms and dries early in spring. Row crops can be grown year after year if a high level of management is applied. The soil is well suited to irrigation. Returning crop residue to the soil or regularly adding other organic material and minimizing tillage help to prevent crusting and increase the rate of water intake.

Compaction and poor tilth can result if pasture is overgrazed or grazed during wet periods, when the soil is soft and sticky. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

Even though only a small acreage is wooded, this soil is well suited to woodland. Plant competition can be controlled by spraying, mowing, or disking.

Although low strength and the shrink-swell potential are limitations, this soil is well suited to building site development. Local roads can be improved by replacing the subsoil with suitable base material. If sanitary facilities are installed on this soil, the effluent can seep into underground water supplies. The soil is a good source of sand and gravel.

The capability subclass is IIs; woodland suitability subclass 2o.

GaB—Gallman loam, 2 to 6 percent slopes. This gently sloping, well drained soil is mainly in the higher positions on stream terraces. Most areas are long and narrow or oval and range from 15 to 30 acres in size.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil is about 60 inches thick. It is dark yellowish brown and brown, friable and very friable loam, sandy clay loam, gravelly clay loam, and sandy loam. The substratum to a depth of about 81 inches is dark grayish brown and light brownish gray, loose coarse sandy loam. In some areas slopes are 0 to 2 percent or 6 to 12 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Digby soils on the lower part of slopes. Also included are some areas where the surface layer is sandy loam, the hazard of soil blowing is more severe, and cultivation is slightly easier. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the Gallman soil. The root zone is deep and has a moderate available water capacity. Runoff is slow or medium. Tilth is good. The shrink-swell potential is low. The upper part of the subsoil is very strongly acid to slightly acid, and the lower part is medium acid to mildly alkaline. Organic matter content is moderate or moderately low.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cropland and for hay, woodland, building site development, and recreational uses.

This soil is well suited to corn, soybeans, wheat, oats, hay, and pasture. It is better suited to early maturing crops than to crops that mature late in summer. Row crops can be grown year after year if erosion is controlled. The soil dries early in spring and is well suited to tilling and grazing early in spring. It is suited to irrigation. The main management need is control of erosion. Keeping tillage at a minimum, returning crop residue to the soil, and including sod crops in the cropping system reduce the risk of erosion, improve tilth, and increase the rate of water intake. Pastures and meadows of shallow-rooted legumes and grasses tend to dry out during periods when rainfall is below normal. Smaller, more frequent or timely applications of fertilizer and lime are better than one large application.

This soil is well suited to trees and to the plants that enhance habitat for openland and woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is well suited to septic tank absorption fields, most kinds of building site development, and recreational uses. The low strength of the subsoil is a severe limitation on sites for local roads and streets, but this limitation can be overcome by providing suitable base material. The effluent from sanitary facilities can seep into underground water supplies.

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

Gn—Genesee silt loam, occasionally flooded. This nearly level, well drained soil is in the highest position on flood plains. Most of the acreage occurs as small, oval and long, narrow areas along the larger streams. Areas range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 32 inches thick. It is dark brown and dark yellowish brown, firm, friable, and very friable silt loam and loam. The substratum to a depth of about 60 inches is dark brown, very friable stratified clay loam and loam. It is mottled in the lower part. In some areas the surface layer is loam.

Included with this soil in mapping are narrow strips of the somewhat poorly drained Shoals soils in slight depressions near slope breaks to the uplands. Included soils make up about 10 percent of most areas.

Permeability is moderate in the Genesee soil. The root zone is deep and has a high available water capacity. Crusting of the surface layer after heavy rains reduces the infiltration rate. Runoff is slow. The subsoil is mildly alkaline or moderately alkaline. Organic matter content is moderate.

Most of the acreage is used for corn, soybeans, and small grain. Some areas are used as permanent pasture or for specialty crops. This soil has high potential for cultivated crops and for woodland. It has low potential for building site development and sanitary facilities.

The major concern in managing this soil as cropland is the flood hazard. Although the choice of crops is limited by this hazard, the soil is well suited to annual field crops (fig. 3) and to specialty crops. Such crops as winter wheat are severely damaged by floodwater in winter and early in spring. The soil is suited to grasses and legumes for pasture. Planting cover crops and incorporating crop residue into the soil increase the organic matter content, help to prevent crusting, and protect the surface during floods.

This soil is well suited to trees and to the plants that enhance habitat for openland and woodland wildlife. Machine planting of tree seedlings is practical on this soil. Spraying, mowing, or disking helps to control plant competition.

This soil is generally unsuitable as a site for buildings, local roads, and sanitary facilities because it is subject to flooding. Diking to control the flooding is difficult. The potential for recreational uses, such as picnic areas and hiking trails, is high. The soil is a good source of topsoil.

The capability subclass is IIw; woodland suitabiity subclass 1o.

GwB—Glynwood silt loam, 2 to 6 percent slopes. This moderately well drained, gently sloping soil is on knolls and along drainageways on ground and end moraines. Most areas are long and narrow or irregularly shaped and range from 2 to 70 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is brown, mottled, friable silt loam about 2 inches

Figure 3.—Harvesting corn on Genesee silt loam, occasionally flooded.

thick. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam and clay, and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, very firm clay loam. In some areas the substratum contains more gravel and some cobblestones. It is stratified with silt loam and sandy loam in a few areas.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils on toe slopes and foot slopes and in nearly level areas. Included soils make up about 10 percent of most areas.

In the Glynwood soil a seasonal high water table is perched between depths of 24 and 42 inches in winter and in spring and other extended wet periods. Permeability is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Tilth is good. Runoff is medium. The shrink-swell potential is moderate. The surface layer is medium acid to neutral. The upper part of the subsoil is very strongly acid to neutral, and the lower part is slightly acid to moderately alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is medium or low. The potential for most recreational uses is medium or high.

This soil is suited to crops and pasture. The erosion hazard and surface crusting are the main concerns of management. Terraces and diversions intercept runoff on long slopes. Including meadow crops in the cropping system and establishing grassed waterways help to control erosion. Randomly spaced subsurface drains are needed in the wetter included soils. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and tilling at proper moisture levels improve tilth, increase the rate of water infiltration, and reduce the risk of erosion. Soil compaction occurs if the soil is tilled, crops are harvested, or pasture is grazed during wet periods, when the soil is soft and sticky. Controlled grazing is needed in pastured areas.

Only a small acreage of this soil is wooded. The soil is well suited to woodland. Seedling mortality is a hazard during extended dry periods.

The seasonal wetness and the shrink-swell potential are moderate limitations if this soil is used as a site for buildings without basements. The wetness is a severe limitation on sites for buildings with basements. Installing drains around footings and coating exterior basement walls help to keep moisture out of basements. The slow permeability and the wetness are severe limitations in septic tank absorption fields. Frost action and low strength are severe limitations on sites for local roads. The roads can be improved by installing a drainage system and by providing suitable base material. This soil is suitable for pond embankments.

The capability subclass is IIe; woodland suitability subclass 2c.

HkA—Haskins loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on very slight rises on stream terraces, end moraines, and ground moraines. Most areas are long and narrow, oval, or irregularly shaped. They range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 42 inches thick. The upper part is brown, mottled, firm fine sandy loam; the next part is dark yellowish brown, mottled, firm sandy clay loam; and the lower part is brown, mottled, very firm clay loam. The substratum to a depth of about 60 inches is brown, mottled, very firm clay loam. In some areas loamy sand or gravelly sandy loam is in the substratum.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils, which formed in glacial till on till plains, and small areas of Pewamo soils in depressions. Included soils make up about 10 percent of most areas.

In the Haskins soil a seasonal high water table is perched between depths of 12 and 30 inches in winter and in spring and other extended wet periods. Permeability is moderate in the upper part of the subsoil and slow or very slow in the lower part and in the substratum. The root zone is moderately deep or deep to compact glacial till or lacustrine material. Available water capacity is moderate. Runoff is slow. The shrink-swell potential is high in the lower part of the subsoil and in the substratum. The upper part of the subsoil is very strongly acid to medium acid, and the lower part is strongly acid to mildly alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, oats, hay, and pasture. Seasonal wetness is the main limitation. Surface drains remove excess surface water. Subsurface drains are commonly used to lower the perched water table. They are more effective if placed on or above the slowly or very slowly permeable glacial till or lacustrine material in the lower part of the subsoil. This soil is well suited to irrigation. Incorporating crop residue into the soil, planting cover crops, and applying barnyard manure increase the organic matter content and improve tilth. Tillage and harvesting are best performed at optimum moisture levels and with the kind of equipment that minimizes soil compaction. Controlled grazing is needed in pastured areas.

This soil is well suited to woodland. The species that can tolerate some wetness should be selected for planting. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings or septic tank absorption fields. Also, the slow or very slow permeability is a severe limitation in septic tank absorption fields and frost action is a severe limitation on sites for local roads. Drainage ditches and subsurface drains can lower the seasonal high water table. Landscaping can keep surface water away from the foundations. Installing drains around footings and coating exterior basement walls help to keep the moisture out of basements. Poured concrete walls can also reduce seepage into basements. Local roads can be improved by installing a drainage system and by providing suitable base material.

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

HkB—Haskins loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on low knolls on stream terraces and end moraines. Most areas are long and narrow or oval and are 5 to 10 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 42 inches thick. The upper part is brown, mottled, firm fine sandy loam; the next part is dark yellowish brown, mottled, firm sandy clay loam; and the lower part is brown, mottled, very firm clay loam. The substratum to a depth of about 60 inches is brown, very firm clay loam. In some areas loamy sand or gravelly sandy loam is in the substratum.

Included with this soil in mapping are small areas of the moderately well drained Glynwood soils on the upper part of slopes and the crest of low knolls and narrow strips of the very poorly drained Pewamo soils in depressions. Also included are small areas of the somewhat poorly drained Blount soils, which formed in glacial till, on end moraines. Included soils make up about 20 percent of most areas.

In the Haskins soil a seasonal high water table is perched between depths of 12 and 30 inches in winter and in spring and other extended wet periods. Permeability is moderate in the upper part of the subsoil and slow or very slow in the lower part and in the substratum. The root zone is moderately deep or deep to compact glacial till or lacustrine material. Available water capacity is moderate. Runoff is medium. The shrink-swell potential is high in the lower part of the subsoil and in the substratum. The upper part of the subsoil is very strongly acid to medium acid, and the lower part is strongly acid to mildly alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development and sanitary facilities is low.

This soil is suited to corn, soybeans, wheat, oats, hay, and pasture. Erosion, especially on long slopes, is the chief hazard and seasonal wetness the chief limitation on cropland. Returning crop residue to the soil, establishing grassed waterways, and including meadow crops in the cropping system help to control erosion. They also increase the organic matter content and improve soil structure and tilth. Subsurface drains can lower the perched water table. These drains are more effective if placed on or above the slowly or very slowly permeable glacial till or lacustrine material in the lower part of the subsoil. Soil compaction occurs if the soil is tilled, crops are harvested, or pasture is grazed during wet periods, when the soil is soft and sticky. Controlled grazing is needed in pastured areas.

This soil is well suited to woodland. The species that can tolerate some wetness should be selected for planting. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings or septic tank absorption fields. Also, the slow or very slow permeability is a severe limitation in septic tank absorption fields and frost action a severe limitation on sites for local roads. Drainage ditches and subsurface drains can lower the perched water table. Installing drains around footings and coating exterior basement walls help to keep moisture out of basements. Poured concrete walls can also reduce seepage into basements. Local roads can be improved by installing a drainage system and by providing suitable base material.

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

La—Latty silty clay. This nearly level, very poorly drained soil is on smooth flats and in shallow depressions on lake plains. It is subject to ponding from runoff from adjacent higher lying areas. Most areas are irregularly shaped and range from 20 to more than 300 acres in size.

Typically, the surface layer is dark gray, firm silty clay about 8 inches thick. The subsoil is mottled, firm silty clay and clay about 37 inches thick. The upper part is dark grayish brown and grayish brown, the next part gray, and the lower part light brownish gray. The substratum to a depth of about 60 inches is grayish brown, calcareous, firm clay.

Included with this soil in mapping are small areas of the somewhat poorly drained McGary and Blount soils on slight rises. Included soils make up about 5 percent of most areas.

In the Latty soil a seasonal high water table is near or above the surface in winter and in spring and other extended wet periods. This soil dries slowly in spring. Permeability is very slow. Runoff is very slow or ponded. The root zone is deep and has a moderate available water capacity. Organic matter content is moderate or high. The shrink-swell potential is high. The soil is sticky when wet and puddles and clods easily. The subsoil is neutral or mildly alkaline.

Most of the acreage is used as cropland. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential for building site development, sanitary facilities, and recreational uses is low.

The excessive wetness, the clayey surface layer, and the very slow permeability are the major limitations in cultivated areas. Undrained areas are too wet for cultivated crops. Drained areas are suited to corn and soybeans. Both surface and subsurface drains are commonly used to improve drainage. Surface crusting, compaction, and clodding can occur unless the soil is tilled and crops are harvested at optimum moisture levels. Returning crop residue to the soil and planting cover crops increase the organic matter content and the rate of water intake and improve tilth.

Drained areas are suited to pasture or hay. Surface compaction, poor tilth, and a decreased infiltration rate result from grazing during wet periods, when the soil is soft and sticky. Selection of grasses and legumes that are tolerant of wetness, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suited to woodland and to habitat for wetland wildlife. Reforestation with desirable species is difficult because of a high seedling mortality rate and severe plant competition. Seedlings can survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. The use of harvesting equipment is limited during wet periods.

The ponding is a severe limitation if this soil is used as a site for buildings, for local roads, for most sanitary facilities, or for recreational areas. Also, the very slow permeability is a severe limitation in septic tank absorption fields, the high shrink-swell potential a severe limitation on building sites, low strength a severe limitation on sites for local roads, and the clayey surface layer a severe limitation in recreational areas. The soil is better suited to houses without basements than to houses with basements. If buildings with basements are constructed, the excavated area along basement walls should be backfilled with soil material having a low shrink-swell potential. Providing suitable base material and installing a drainage system can improve local roads. Extensive drainage is needed in intensively used recreational areas.

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

McA—McGary silt loam, 0 to 4 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is on flats and very slight rises on old shallow glacial lakes. Most areas are oval or irregularly shaped and range from 2 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is grayish brown, dark yellowish brown, and brown, mottled, firm silty clay loam and silty clay about 27 inches thick. The substratum to a depth of about 60 inches is yellowish brown and dark yellowish brown, firm silty clay. It is mottled in the upper part.

Included with this soil in mapping are narrow strips of the very poorly drained Montgomery and Latty soils in depressions. These soils are subject to ponding. They make up 5 to 10 percent of most areas.

In the McGary soil a seasonal high water table is between depths of 12 and 36 inches in winter and in spring and other extended wet periods. Permeability is slow or very slow. The root zone is mainly moderately deep to compact lakebed sediments and has a moderate available water capacity. Tilth is good. Runoff is slow or medium. The shrink-swell potential is high. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline. Organic matter content is moderate.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland. The potential is low for building site development and sanitary facilities. It is medium or low for recreational uses.

Drained areas are suited to corn, soybeans, wheat, oats, hay, and pasture. Wetness is the main management concern. Surface drains are used to remove ponded water. Subsurface drains generally help to remove the excess water from the root zone, but the movement of water into these drains is slow. The soil puddles and clods if worked during wet periods, when it is soft and sticky. It is poorly suited to grazing early in spring because it is wet. Including meadow crops in the cropping system, returning crop residue to the soil, and planting cover crops improve tilth, increase the organic matter content, and help to control erosion. Controlled grazing is beneficial in pastured areas.

This soil is suited to trees. The species selected for planting should be those that can grow in a somewhat poorly drained soil that has a moderately fine textured and fine textured subsoil. Plant competition can be controlled by spraying, mowing, or disking.

The seasonal wetness is a severe limitation if this soil is used as a site for buildings or septic tank absorption fields. Also, the slow or very slow permeability is a severe limitation in septic tank absorption fields and the high shrink-swell potential a severe limitation on sites for local roads. Landscaping can keep surface water away from the foundations. This soil is better suited to houses without basements than to houses with basements. If buildings with basements are constructed, the excavated area along basement walls should be backfilled with soil material having a low shrink-swell potential. Installing foundation drains and coating exterior basement walls help to keep moisture out of basements. Local roads can be improved by installing a drainage system and by providing suitable base material.

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

Mf—Milford silty clay. This nearly level, very poorly drained soil is in an old shallow glacial lake. It is subject to ponding from runoff from adjacent higher lying areas. The area is broad and irregularly shaped and is about 3,000 acres in size.

Typically, the surface layer is very dark brown, firm silty clay about 10 inches thick. The subsoil is about 43 inches thick. The upper part is gray, mottled, very firm silty clay, and the lower part is gray and yellowish brown, mottled, firm and very firm silty clay loam. The substratum to a depth of about 60 inches is dark gray, mottled, firm silty clay loam. In many large areas the surface layer is silty clay loam. In some areas the lower part of the subsoil and the substratum are silty clay.

Included with this soil in mapping are small areas of the somewhat poorly drained McGary and Blount soils on slight rises. Included soils make up about 15 percent of most areas.

In the Milford soil a seasonal high water table is near or above the surface in spring and other extended wet periods. Permeability is moderately slow. The root zone is deep and has a high available water capacity. Tilth is poor. Runoff is very slow or ponded. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. Organic matter content is high. The shrink-swell potential is moderate.

Most areas are used as cropland. This soil has high potential for row crops and small grain and low potential for building site development, sanitary facilities, and recreational uses. Undrained areas are well suited to habitat for wetland wildlife.

Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. The main limitations are the very poor natural drainage and the clayey surface layer. In some years stands of wheat and oats are poor in areas where good drainage is not provided. Surface drains commonly remove excess surface water. Subsurface drains can help to remove free water from the subsoil. Grade-changing structures in areas where the water from surface drains enters the deeper outlet ditches help to control erosion. This soil can be tilled only within a narrow range of moisture content. Clods form and tilth deteriorates if the soil is tilled during wet periods, when it is soft and sticky. If pastures are grazed and trampled when too wet, the soil becomes compacted and hard. Managing crop residue and planting cover crops improve tilth and increase the rate of water infiltration.

Ponding is a severe limitation if this soil is used as a site for buildings, local roads, sanitary facilities, or recreational areas. Also, the moderately slow permeability is a severe limitation in septic tank absorption fields, low strength and frost action are severe limitations on sites for local roads, and the clayey surface layer is a severe limitation in recreational areas. Local roads can be improved by installing a drainage system and by providing suitable base material.

The capability subclass is IIw; no woodland suitability subclass is assigned.

Mk—Millgrove clay loam. This nearly level, very poorly drained soil is in low lying positions on stream terraces and outwash plains. It is subject to ponding from runoff from adjacent higher lying areas. It occurs as broad, irregularly shaped areas that are several thousand acres in size and as irregularly shaped or long and narrow areas that are 10 to 40 acres in size.

Typically, the surface layer is very dark gray, firm clay loam about 11 inches thick. The subsoil is about 28 inches thick. The upper part is dark gray and gray, mottled, firm clay loam, and the lower part is dark grayish brown and gray, mottled, friable loam. The substratum to a depth of about 60 inches is gray and dark grayish brown, very friable and loose gravelly sandy loam and sand. In some areas the subsoil is moderately alkaline. In other areas the substratum contains more gravel and some cobblestones.

Included with this soil in mapping are small areas of the somewhat poorly drained Digby and Digby Variant soils on slight rises. Also included are frequently flooded areas along the St. Marys and Auglaize Rivers and small areas, in depressions, where free lime is in the surface layer. Included soils make up about 15 percent of most areas.

In the Millgrove soil a seasonal high water table is near or above the surface in fall and winter and in spring and other extended wet periods. Permeability is moderate. The root zone is deep and has a high available water capacity. Tilth is fair to good. Runoff is very slow or ponded. The subsoil has a moderate shrink-swell potential. It is slightly acid to mildly alkaline. Organic matter content is high.

Most areas are used for cash grain farming. This soil has high potential for row crops, small grain, hay, pasture, and woodland. The potential for building site development, sanitary facilities, and recreational uses is low.

Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture and to specialty crops. Unless adequate drainage is provided, poor stands of wheat and oats can be expected in most years. Surface drains can remove excess surface water (fig. 4). Subsurface drains commonly help to remove excess water from the root zone. The soil is well suited to irrigation. Timely tillage is important because the soil puddles and clods if worked during wet periods, when it is soft and sticky. Cultivated crops can be grown year after year if good tilth is maintained. Managing crop residue and planting cover crops improve tilth, help to control erosion, and increase the rate of water infiltration. Controlled grazing helps to prevent

Figure 4.—Open ditch used to remove excess water from very poorly drained Millgrove clay loam. The ditchbanks are well protected with grass.

compaction in pastured areas. In the frequently flooded, included areas, corn and soybeans should not be planted until after the period of most flooding.

This soil is suited to woodland. The species that can tolerate wetness should be selected for planting. Logging should be done during the drier part of the year. Spraying, disking, or mowing helps to control plant competition. Undrained areas are well suited to habitat for wetland wildlife.

Ponding is a severe limitation if this soil is used for building site development, sanitary facilities, or recreational areas. Also, the effluent from sanitary facilities can pollute underground water supplies and frost action is a severe hazard on sites for local roads. Providing suitable base material and installing a drainage system improve local roads.

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

Mp—Montgomery silty clay. This nearly level, very poorly drained soil is in depressions in old shallow glacial lakes and in some areas along drainageways that have a low gradient. It is subject to ponding from runoff from adjacent, higher lying soils. Most areas are large, broad, and irregularly shaped. Areas that are only 3 to 20 acres in size are oval, long and narrow, or irregularly shaped.

Typically, the surface layer is very dark gray, friable silty clay about 8 inches thick. The subsoil is mottled, firm and very firm silty clay about 34 inches thick. It is very dark gray in the upper part and gray in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled, firm silty clay loam. In places the surface layer is silty clay loam. In a few areas the soil is underlain with calcareous glacial till or sand and gravel. The lower part of the subsoil and the substratum are silty clay loam or silt loam in some areas.

Included with this soil in mapping are areas along drainageways that are subject to flooding. Also included are Pewamo soils on the edges of some mapped areas and small areas of the somewhat poorly drained McGary and Blount soils on slight rises. Included soils make up about 15 percent of most areas.

In the Montgomery soil a seasonal high water table is near or above the surface in winter and in spring and other extended wet periods. Permeability is slow or very slow. The root zone is mainly deep and has a high available water capacity. Tilth is poor. Runoff is very slow or ponded. The subsoil is slightly acid or neutral in the upper part and slightly acid to mildly alkaline in the lower part. Organic matter content is high. The shrink-swell potential is high in the subsoil and moderate in the substratum.

Most areas are used for cash grain and livestock farming. This soil has high potential for cultivated crops and woodland and low potential for building site development, sanitary facilities, and recreational uses.

Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. The main limitations are the very poor natural drainage and the clayey surface layer. In some years stands of wheat and oats are poor in areas where good drainage is not provided. Surface drains commonly are used to remove excess surface water. Subsurface drains can remove free water from the subsoil. Grade-changing structures in areas where the water from surface drains enters the deeper outlet ditches help to control erosion. This soil can be tilled only within a narrow range of moisture content. Clods form and tilth deteriorates if the soil is tilled during wet periods, when it is soft and sticky. If pastures are grazed and trampled when too wet, the soil becomes compacted and hard. Managing crop residue and planting cover crops improve tilth and increase the rate of water infiltration.

This soil is suited to trees and to the plants that enhance habitat for wetland wildlife. Species that can tolerate wetness should be selected for planting. Logging can be done during the drier part of the year. Plant competition can be controlled by spraying, mowing, or disking. Undrained areas are well suited to habitat for wetland wildlife.

Ponding is a severe limitation if this soil is used for building site development, sanitary facilities, and recreational areas. Also, the slow or very slow permeability is a severe limitation in septic tank absorption fields and in many recreational areas, the high shrink-swell potential in the subsoil a severe limitation on sites for buildings and local roads, the clayey surface layer a severe limitation in recreational areas, and low strength a severe limitation on sites for local roads. The roads can be improved by installing a drainage system and by providing base material.

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

MrC2—Morley clay loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on short slopes on the sides of valleys and hills on the dissected parts of ground and end moraines. Most areas are long and narrow and are 2 to 10 acres in size.

Typically, the surface layer is brown, firm clay loam about 4 inches thick. The subsoil is brown, dark yellowish brown, and yellowish brown, mottled, firm clay and clay loam about 30 inches thick. The substratum to a depth of about 60 inches is brown, mottled, calcareous, very firm clay loam. In some areas, the soil is wetter and the subsoil is gray.

Included with this soil in mapping are small, severely eroded areas where tilth is poor. Also included are small areas of Eldean soils, which are underlain by sand and gravel. Included soils make up 10 to 20 percent of most areas.

Permeability is slow in the Morley soil. Available water capacity is moderate. Runoff is rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic matter content is moderately low. Tilth is fair. The upper part of the subsoil is strongly acid to neutral, and the lower part is neutral to moderately alkaline. The shrink-swell potential is moderate.

Most of the acreage is used as cropland. This soil has medium potential for cultivated crops and high potential for hay, pasture, and trees. The potential is medium for building site development and low or medium for sanitary facilities.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The main concerns of management are reducing the severe hazard of erosion and improving tilth. If cultivated crops are grown, further erosion damage can occur. Including grasses and legumes in the cropping system helps to control erosion and improves tilth in cultivated areas. A few areas have long, smooth slopes that can be farmed on the contour. If plowed when wet and sticky, the soil becomes cloddy. It puddles and crusts easily. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and tilling at proper moisture levels increase the rate of water infiltration, help to prevent crusting, and reduce the risk of erosion.

Surface compaction, poor tilth, reduced productivity, and increased runoff result from overgrazing and from grazing when the soil is too wet. Proper stocking rates, careful plant selection, pasture rotation, timely deferment of grazing, and applications of a proper amount and kind of fertilizer help to keep the pasture and the soil in good condition.

This soil is well suited to trees. A few areas support native hardwoods. Seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

The slope and the slow permeability are severe limitations if this soil is used as a site for sanitary facilities, and the slope and the shrink-swell potential are moderate limitations on sites for buildings. The soil is suited to building site development and sanitary facilities only if proper design and installation procedures are used. Maintaining as much plant cover as possible on construction sites reduces the risk of erosion. Providing suitable base material improves local roads by overcoming the risk of damage caused by low strength. This soil is suitable for pond embankments.

The capability subclass is IIIe; woodland suitability subclass 2o.

MrD2—Morley clay loam, 12 to 18 percent slopes, eroded. This moderately steep, well drained soil is on short slopes on the sides of valleys and hills on the dissected parts of ground and end moraines. About half of the original surface layer has been lost through erosion. Most areas are long and narrow and are 2 to 20 acres in size.

Typically, the surface layer is dark brown, firm clay loam about 4 inches thick. The subsoil is dark yellowish brown, mottled, firm silty clay and clay loam about 24 inches thick. The substratum to a depth of about 60 inches is brown, mottled, very firm clay loam. In some areas on moraines stratified silt loam and sandy loam are in the substratum. In a few areas small stones in the surface layer interfere with tillage.

Included with this soil in mapping are areas of very steep soils. The surface layer of the included soils is thinner than that of the Morley soil, and depth to the substratum is 6 to 20 inches. Included soils make up 15 percent of most areas.

Permeability is slow in the Morley soil. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate, and the soil is droughty during extended dry periods because of water lost as runoff. Runoff is very rapid. Tilth is fair. Reaction ranges from strongly acid to neutral in the upper part of the subsoil and from neutral to moderately alkaline in the lower part. It varies widely in the surface layer, depending on past liming practices. Organic matter content is moderately low. The shrink-swell potential is moderate.

Most of the acreage is used as woodland or pasture. In some areas this soil is cultivated along with adjacent soils on flood plains and uplands. It has low potential for cultivated crops, for building site development and sanitary facilities, and for most recreational uses. It has high potential for woodland and for woodland wildlife habitat.

This soil is better suited to hay and pasture than to row crops, but row crops can be grown occasionally if erosion is controlled and good management is applied. The main concerns of management are reducing the very severe hazard of erosion and improving tilth. The short slopes cause some problems in the operation of machinery and in the installation of erosion-control measures. If plowed when sticky and wet, the soil becomes cloddy. It puddles and crusts easily. Minimizing tillage, managing crop residue, planting cover crops, and tilling and harvesting at proper moisture levels help to control erosion and improve tilth. Erosion can be controlled on pastures by reseeding with cover crops or companion crops or by trash mulch or no-till seeding methods. A thick plant cover helps to control erosion. Controlled grazing reduces soil compaction and increases plant growth.

This soil is suited to woodland. The slope moderately limits the use of equipment. Logging roads and skid trails should be established across the slope and otherwise protected against erosion.

The slope is a severe limitation if this soil is used as a site for most buildings, most recreational areas, and sanitary facilities. Also, the slow permeability is a severe limitation in septic tank absorption fields. Maintaining as much plant cover as possible on construction sites reduces the risk of erosion. Trails in recreational areas should be established across the slope and otherwise protected against erosion.

The capability subclass is IVe; woodland suitability subclass 2r.

Mu—Muskego muck. This nearly level, very poorly drained soil is in low areas on outwash plains and till plains. It is subject to ponding from runoff from adjacent higher lying areas. Most areas are irregularly shaped and range from 5 to 60 acres in size.

Typically, the surface layer is black, friable muck about 8 inches thick. The next 14 inches also is black, friable muck. Below this to a depth of about 60 inches is black, very dark grayish brown, and dark gray, slightly sticky sedimentary peat.

A seasonal high water table is near or above the surface for long periods. Permeability is moderately rapid to moderately slow in the muck and slow in the sedimentary peat. Runoff is very slow. The root zone is deep and has a very high available water capacity. It ranges from medium acid to moderately alkaline. Organic matter content is very high.

Most of the acreage is used as cropland. A few areas are used as habitat for wetland wildlife. This soil has high potential for cropland and for habitat for wetland wildlife. The potential for building site development, sanitary facilities, and recreational uses is low.

This soil is suitable as cropland if adequately drained. The very poor natural drainage, the ponding, the poor trafficability, and the slow permeability in the underlying sedimentary peat are the major limitations. Cultivated crops are well suited and can be grown year after year if optimum management is applied. Small grain is not well suited, however, because of the ponding and the possibility of lodging or frost heave. Subsurface drains and open ditches help to remove excess water. Constructing or maintaining outlets is expensive in some areas. Ditchbanks are unstable. Subsidence or shrinkage occurs after the soil is drained. As a result, subsurface drains are displaced. Because the soil is made up of fine particles, soil blowing is a major hazard in the larger areas. Planting cover crops, returning crop residue to the soil, establishing windbreaks, and irrigating reduce the risk of soil blowing. Fire is a hazard during extended dry periods.

This soil is suited to the grasses grown for hay or pasture. Legumes, such as alfalfa, are not well suited because of the frost heave and the wetness. Water-tolerant grasses, especially reed canarygrass, grow well. Overgrazing and grazing during wet periods, when the soil is soft and sticky, damage the pasture.

This soil generally is not well suited to trees unless it is drained. Undrained areas can support water-tolerant trees and some cattails, reeds, and sedges. Wetness seriously limits the use of logging equipment. The windthrow hazard can be reduced by planting deep rooted species.

Because of the ponding, this soil is unsuitable as a site for buildings and sanitary facilities. Low strength and ponding are severe limitations on sites for local roads. The roads can be improved by replacing the organic deposit with suitable base material and by installing a drainage system. Undrained areas provide good habitat for duck, muskrat, and other kinds of wetland wildlife.

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

Po—Pewamo silt loam, overwash. This nearly level, very poorly drained soil is in small, oval depressions on ground moraines and in long, narrow areas on end moraines. It is overlain by 10 to 20 inches of local alluvium from adjacent soils. It is subject to ponding from runoff from adjacent higher lying areas. Most areas are 2 to 30 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 18 inches thick. The subsurface layer is very dark grayish brown, mottled, firm silty clay loam about 16 inches thick. The subsoil to a depth of about 60 inches is dark gray, mottled, very firm silty clay. In some areas the subsurface layer and subsoil are clay loam. In other areas the local alluvium is 20 to 36 inches thick.

Included with this soil in mapping are the Montgomery soils, which formed in lakebed sediments in depressions, and the somewhat poorly drained Blount soils on slight rises. Included soils make up about 10 percent of most areas.

In the Pewamo soil a seasonal high water table is near or above the surface in winter and in spring and other extended wet periods. Permeability is moderately slow. The root zone is deep and has a high available water capacity. Runoff is very slow or ponded. The shrink-swell potential is moderate in the subsurface layer and the subsoil. Tilth is good. The subsoil is slightly acid to mildly alkaline. Organic matter content is moderate.

Most areas are used for cash grain farming. Corn, soybeans, small grain, hay, and pasture are the principal crops. This soil has high potential for cultivated crops for hay, pasture, and woodland, and in undrained areas, for wetland wildlife habitat. It has low potential for building site development, sanitary facilities, and recreational uses.

Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. The very poor natural drainage is the main limitation. Stands of wheat and oats in inadequately drained areas are poor in some years. A combination of subsurface and surface drains is commonly used to improve drainage. The effectiveness of some of the older subsurface drains is impaired because the lines are too deep. Returning a large amount of crop residue to the soil increases the organic matter content and helps to prevent crusting. Deferment of grazing during wet periods, when the soil is soft and sticky, helps to prevent compaction.

This soil is well suited to woodland and to habitat for wetland wildlife. Wetness limits the use of harvesting equipment. The trees that can tolerate wetness should be selected for planting.

The ponding is a severe limitation if this soil is used as a site for buildings, local roads, sanitary facilities, or recreational areas. Also, the moderately slow permeability is a severe limitation in septic tank absorption fields and frost action and low strength are severe limitations on sites for local roads. The roads can be improved by installing a drainage system and by providing suitable base material.

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

Pw—Pewamo silty clay loam. This nearly level, very poorly drained soil is in depressions and along drainageways on ground and end moraines. It occurs as large, irregularly shaped areas connecting many drainageways on ground moraines and as long and narrow areas in drainageways on end moraines. It is subject to ponding from runoff from adjacent higher lying areas. Most areas are 10 to 100 acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, mottled, very firm silty clay loam about 4 inches thick. The subsoil is about 46 inches thick. The upper part is grayish brown and gray, mottled, very firm silty clay and clay, and the lower part is grayish brown, mottled, very firm clay loam. The substratum to a depth of about 60 inches is gray, mottled, very firm clay loam. In some small areas alluvial sediments overlie the original surface layer.

Included with this soil in mapping are small areas, on slight rises, of the somewhat poorly drained Blount soils, which are subject to surface crusting, and in depressions, small areas of Montgomery soils, which formed in lakebed sediments. Included soils make up about 15 percent of most areas.

In the Pewamo soil a seasonal high water table is near or above the surface in winter and in spring and other extended wet periods. Permeability is moderately slow. The root zone is deep and has a high available water capacity. The soil puddles and clods easily. Runoff is very slow or ponded. The shrink-swell potential is moderate. The subsoil is slightly acid to mildly alkaline. Organic matter content is high.

Most areas are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has high potential for cultivated crops and for hay, pasture, and woodland and low potential for building site development, sanitary facilities, and recreational uses.

Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. The very poor natural drainage is the main limitation. Stands of wheat and oats in inadequately drained areas are poor in some years. A combination of subsurface and surface drains (fig. 5) is used to improve drainage. Grassed waterways are used in many areas (fig. 6). If cropping is intensive, a large amount of crop residue should be returned to the soil. Tillage within a limited range of moisture content is important because this soil becomes compacted and cloddy if worked when wet and sticky. Deferment of grazing during wet periods, when the soil is soft and sticky, helps to prevent compaction.

This soil is well suited to woodland and, in undrained areas, to habitat for wetland wildlife. Wetness limits the use of harvesting equipment. The trees that can tolerate wetness should be selected for planting.

The ponding is a severe limitation if this soil is used as a site for buildings, local roads, sanitary facilities, or recreational areas. Also, the moderately slow permeability is a severe limitation in septic tank absorption fields and frost action and low strength are severe limitations on sites for local roads. The local roads can be improved by installing a drainage system and by providing suitable base material.

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

Px—Pits, gravel. Gravel pits consist of surface-mined areas from which sand and gravel have been removed for use in construction. They are mainly on kames and in other areas where the soils formed in glacial outwash. Most range from 5 to 60 acres in size. Actively mined pits are continually being enlarged. Most pits have high walls on one or more sides. Some contain small ponds.

The material that is mined consists mainly of stratified layers of gravel and sand of varying thickness and orientation. The kind and grain size of aggregates are generally uniform within any one layer but commonly differ from layer to layer. Selectivity in mining is commonly feasible.

Included with the gravel pits in mapping is a limestone quarry at Buckland.

The material remaining after mining is poorly suited to plants. Organic matter content and available water capacity are very low. If surface soil is stockpiled and spread over an area after mining is terminated, plant growth is fair.

Some of the gravel pits that are no longer used support weeds and trees. Those that contain ponds are suitable for development as habitat for wildlife and recreational areas. A few of the other pits are used for disposal of trash, and some small pits have been

Figure 5.—Installing tile drains in Pewamo silty clay loam.

Figure 6.—Recently seeded grassed waterway on Pewamo silty clay loam. Grassed waterways help to control erosion.

smoothed and farmed. If these areas are used as sites for sanitary facilities, pollution of the underground water supplies is a hazard.

No capability class or subclass or woodland suitability subclass is assigned.

Sh—Shoals silt loam, occasionally flooded. This nearly level, somewhat poorly drained soil is on flood plains. It occupies the entire flood plain along some small streams. Along the larger streams, it is in low-lying areas near slope breaks to the uplands. Areas are broad, long and narrow, or irregularly shaped. They range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The substratum to a depth of about 60 inches is mottled and friable. It is brown silt loam in the upper part; grayish brown and dark grayish brown silty clay loam, clay loam, and loam in the next part; and brown sandy loam in the lower part. In some small areas the surface layer is loam or silty clay loam. In some narrow strips slopes are 2 to 5 percent.

Included with this soil in mapping are small areas of the very poorly drained Sloan soils in depressions and old stream channels and narrow strips of the well drained Genesee soils adjacent to small streams. Also included are some areas where, as a result of organic material in the lower part of the subsoil, strength is low.

In the Shoals soil a seasonal high water table is between depths of 12 and 36 inches in winter and in spring and other extended wet periods. Permeability is moderate. The root zone is deep and has a high available water capacity. Crusting of the surface layer after heavy rains reduces the infiltration rate. Runoff is very slow. The root zone is mainly slightly acid to mildly alkaline. Organic matter content is moderate.

Most of the acreage is used for corn and soybeans. Some areas on narrow flood plains are used for hay or as permanent pasture. This soil has high potential for cultivated crops and for woodland and low potential for building site development and sanitary facilities.

The flooding and seasonal wetness are the main concerns in managing cropland. They delay planting in most years and limit the choice of crops. This soil is suited to the varieties of corn and soybeans that can be planted after the major threat of flooding. Such crops as winter wheat can be severely damaged by floodwater. Subsurface drainage is needed, but suitable outlets are not available in some areas. The soil is suited to pasture, but maintaining soil tilth and desirable forage stands is difficult unless the soil is drained and grazing is controlled. Planting cover crops and managing crop residue improve tilth, help to prevent crusting, and protect the surface in areas that are subject to scouring.

This soil is suited to trees and to the plants that enhance wildlife habitat. The species that can tolerate some wetness should be selected for reforestation. Spraying, disking, or mowing helps to control plant competition.

This soil is generally unsuitable as a site for buildings, local roads, and sanitary facilities because it is subject to flooding. Diking to control the flooding is generally difficult. The soil has potential for such recreational uses as hiking during the drier part of the year.

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

So—Sloan silty clay loam, frequently flooded. This nearly level, very poorly drained soil is on flood plains. It commonly occupies the entire flood plain along small streams. Along the larger streams, it is in depressions near slope breaks to the uplands. Most areas are broad, long and narrow, or irregularly shaped and range from 20 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown, firm silty clay loam about 10 inches thick. The subsurface layer is very dark grayish brown, mottled, firm silty clay loam about 4 inches thick. The subsoil is dark grayish brown, mottled, firm silty clay loam and clay loam about 20 inches thick. The substratum to a depth of about 60 inches is dark gray and dark grayish brown, mottled, friable and firm sandy clay loam and sandy loam. In some small areas the surface layer is silt loam, and in other areas the surface layer and subsurface layer are thinner.

Included with this soil in mapping are narrow strips of the somewhat poorly drained Shoals soils on very slight rises. Also included are Millgrove soils that formed in glacial outwash on low stream terraces. Included soils make up about 10 percent of most areas.

In the Sloan soil a seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is moderate or moderately slow. The root zone is deep and has a high available water capacity. Tilth is fair. Runoff is very slow, and the soil is subject to ponding. The shrink-swell potential is moderate in the subsoil. The upper part of the subsoil is neutral or mildly alkaline, and the lower part is mildly alkaline. Organic matter content is high.

Most of the acreage is used for row crops, pasture, and woodland. The potential for cultivated crops, for pasture and hay, and for woodland is high. The potential for building site development, sanitary facilities, and recreational uses is low.

The flooding and the seasonal wetness are the main concerns in managing the areas used as cropland. Winter crops and early spring crops are usually not grown because of the flood hazard. Drained areas are suited to row crops and pasture. Surface drains are used in a few areas to remove ponded water. Subsurface drains are also used in areas where suitable outlets are available. Outlets are not available in some areas because of the water level in adjacent streams. The soil becomes compacted and cloddy if worked when wet and sticky. Deferment of grazing during wet periods, when the soil is soft and sticky, helps to prevent compaction. Planting cover crops and managing crop residue improve tilth and protect the surface in areas that are subject to scouring.

This soil is suited to trees and to the plants that enhance wildlife habitat. Harvesting equipment is limited during wet periods. The trees that can tolerate wetness should be selected for reforestation. Spraying, mowing, or disking helps to control plant competition.

This soil is unsuitable as a site for buildings, local roads, sanitary facilities, and recreational areas because it is subject to flooding.

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

Ud—Udorthents, loamy, rolling. These soils are mainly in areas of cut and fill, where the cuts have been deep enough to remove all or nearly all of the surface layer and subsoil and the fill material is more than 20 inches deep over the original soil. Most of the areas are the berms, median strips, ditches, or interchanges of the major highway systems. Some have been filled or covered with miscellaneous material, such as household or factory waste products. Some of the miscellaneous material has been covered with earthy material. A few areas are borrow pits where the remaining material is typically similar to the material in the subsoil or substratum of adjacent soils. Slopes range from 0 to 25 percent.

Typically, the upper 60 inches is clay loam or silty clay loam. The soil material commonly is in poor physical condition. Available water capacity is very low in the root zone. Tilth is poor. Hard rains tend to seal the soil surface and thus reduce the infiltation rate and restrict the emergence and growth of seedlings. A seasonal high water table is evident in some areas, particularly in depressed or bowl-shaped areas where water accumulates.

The erosion hazard is very severe if the surface is bare. In many areas smoothing and seeding are needed to reduce the risk of erosion. Some areas should be blanketed with topsoil, and other highly erodible areas should be sodded.

The suitability of these soils for building site development and sanitary facilities varies.

No capability class or subclass or woodland suitability subclass is assigned.

use and management of the soils

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

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

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

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

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

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

crops and pasture

David E. Sanders, district conservationist, Soil Conservation Service, helped prepare this section.

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

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

More than 205,000 acres in the survey area was used for crops and pasture in 1967, according to the Conservation Needs Inventory (*8*). Of this total, about 9,500 acres was used only for pasture; 105,500 acres for row crops, mainly corn and soybeans; 40,000 acres for close-grown crops, mainly wheat and oats; and 31,000 acres for rotation hay and pasture. The rest was mainly idle cropland.

The acreage used for crops and pasture in this county has not been so affected by urban development and other uses as that in other parts of the state. According to the 1974 Census of Agriculture, about 90 percent of the total acreage in the county is farmland. According to the Conservation Needs Inventory, only about 12,000 acres, or 5 percent of the total land area, was used for purposes other than cropland, pasture, or woodland in 1967 (*8*).

Soil erosion is a major problem on slightly less than half of the cropland and pasture in Auglaize County. If the slope is more than 2 percent, erosion is a hazard. Loss of the surface layer through erosion reduces the productivity of soils and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as the Blount and McGary soils. Erosion also reduces the productivity of soils that tend to be droughty, such as the Eldean soils. Control of erosion helps to maintain the productivity of soils and improves the quality of water for municipal use, for recreation, and for fish and wildlife by minimizing the pollution of streams.

Soil erosion and wetness are limitations on some soils in the county, especially on the Blount, Digby, and Haskins soils that have slopes of 2 to 6 percent.

In eroded spots on many gently sloping and sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface soil has been eroded away. Such spots are common on the eroded Morley soils.

Erosion control provides a protective plant cover, reduces the runoff rate, and increases the infiltration rate. A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, where part of the acreage is pasture and hayland, including legumes and grasses in the cropping system not only provides nitrogen and improves tilth for the following crops but also reduces the risk of erosion.

Slopes are so short and irregular in most areas of the Glynwood and Morley soils that contour tillage or terracing is not practical. On these soils a cropping system that provides substantial plant cover is needed unless erosion is controlled by a conservation tillage system that leaves crop residue on the surface. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. They are suited to many of the soils in the survey area but are less successful on the eroded soils. No-tillage for corn, which is common on an increasing acreage, is effective in reducing the risk of erosion on gently sloping and sloping soils.

Terraces and diversions reduce the length of slopes, the runoff rate, and the risk of erosion. Many of the soils in Auglaize County, however, are not well suited to terraces and diversions because slopes are irregular, the terrace channels are excessively wet, and the clayey subsoil is exposed in the channels.

Grassed waterways are natural or constructed outlets that are protected by a grass cover. Natural drainageways are the best sites for waterways, partly because a good channel commonly can be established with a minimum of shaping. The waterway should be wide and flat so that farm machinery can cross it easily.

Contour farming and stripcropping help to control erosion, but their use is limited in Auglaize County because the slopes are generally irregular. Contour farming and even stripcropping are practical in some areas of the gently sloping and sloping Eldean, Gallman, Glynwood, and Morley soils.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in the local office of the Soil Conservation Service.

Soil drainage is the major management need on about three-fourths of the acreage used for crops and pasture in the survey area. Some soils are naturally so wet that the production of crops commonly grown in the area is generally not possible without artificial drainage. These are the very poorly drained Milford, Millgrove, Montgomery, Pewamo, Sloan, Latty, Carlisle, and Muskego soils, which make up about 30 percent of the survey area.

Unless artificially drained, the somewhat poorly drained Blount, Defiance, Digby, Haskins, McGary, Del Rey, and Shoals soils are so wet that productivity is reduced during most years. These soils make up about 50 percent of the survey area.

In Morley soils natural drainage is good most of the year, but the soils tend to dry out slowly after rains. Small areas of wetter soils along drainageways and in swales are commonly included with the moderately well drained Glynwood soils in mapping. Artificial drainage is needed in some of these wetter areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drains and subsurface drains is needed in most areas of the very poorly drained soils that are intensively row cropped. The drains should be more closely spaced in slowly or very slowly permeable soils than in the more rapidly permeable soils. Subsurface drainage is slow in Montgomery, Defiance, Milford, Blount, Del Rey, McGary, and Latty soils. Finding adequate outlets for tile drainage systems is difficult in many areas of the Carlisle, Montgomery, Milford, Sloan, Defiance, Shoals, and Muskego soils.

Organic soils oxidize and subside when the pore space is filled with air; therefore, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of organic soils.

Information about the design of drainage systems for each kind of soil is contained in the Technical Guide, available in the local office of the Soil Conservation Service.

Soil fertility is affected by reaction and by the content of plant nutrients. It is naturally low in many soils on uplands. The soils on flood plains, such as the Defiance, Genesee, Shoals, and Sloan soils, have a slightly acid to mildly alkaline surface layer and are naturally higher in content of plant nutrients than most upland soils. The Montgomery, Millgrove, and Pewamo soils, in depressions and drainageways, have a medium acid to neutral surface layer.

Many of the light colored soils on uplands are naturally strongly acid or very strongly acid. Unless these soils have been limed, applications of ground limestone are needed to raise the pH level sufficiently for alfalfa and other crops to grow well. Available phosphorus and potash levels are naturally low in many of these soils. On all soils additions of lime and fertilizer should be based on the results of soil tests, on the need of the crops, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

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

Many of the soils used for crops in the survey area have a silt loam surface layer that is light in color and moderate or moderately low in organic matter content. Generally, intense rainfall causes the surface soil to puddle and compact. As the soil dries, a crust forms at the surface. Because it is hard when dry and nearly impervious to water, the crust reduces the infiltration rate and increases the runoff rate. Regular additions of crop residue, manure, and other organic material improve the soil structure and help to prevent crusting.

Fall plowing is generally not a good practice on the soils with a light colored surface layer. If plowed in the fall, many of these soils are nearly as dense and hard at planting time as they were before they were plowed. Also, gently sloping to moderately steep soils and even some areas of nearly level soils are subject to erosion and soil blowing if they are plowed in the fall.

The dark colored surface layer of Milford, Millgrove, Montgomery, Pewamo, and Sloan soils contains more clay than the surface layer of the light colored soils. Poor tilth can be a problem because these soils often stay wet until late in spring. If they are plowed when wet, the soils tend to be very cloddy when dry. As a result of the cloddiness, preparing a good seedbed is difficult. Fall plowing generally results in good tilth in spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Corn and soybeans are the main row crops. Wheat and oats are the most common close-grown crops. Rye, barley, buckwheat, sunflowers, grain sorghum, alfalfa, and flax could be grown, and grass seed could be produced from bromegrass, fescue, timothy, and bluegrass. Also, legume seed from red clover and alsike clover could be produced.

Special crops of tomatoes, sweet corn, potatoes, and melons are commonly grown in the county. The acreage used for such crops and other vegetables and small fruits could be increased if economic conditions were favorable.

The soils that have good natural drainage and warm early in spring are especially well suited to many vegetables and small fruits. These are the Eldean and Gallman soils that have slopes of less than 6 percent. There are about 4,100 acres of these soils in the survey area. Crops can generally be planted and harvested earlier on these soils than on the other soils in the survey area.

If adequately drained, the muck soils are well suited to a wide range of vegetable crops. These are the Carlisle and Muskego soils, which make up about 300 acres in the survey area. The latest information about growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Permanent pasture makes up 4 percent of the acreage on farms. This low percentage is partly the result of the high percentage of forage provided by meadow crops. Some permanent pastures are on eroded soils that formerly were cultivated and in narrow strips and irregularly shaped areas of frequently flooded soils. Open woodlots are also pastured, but they generally provide poor quality grazing because forage plants are sparse. Many permanent pastures near farmsteads are used for feedlots or access lanes.

Most of the soils in the county could be used for high quality permanent pasture. Sloping to moderately steep soils, such as the Morley soils, are commonly eroded, are low in fertility, and have a limited amount of available water because runoff is rapid or very rapid. As a result, forage production is limited. Pasture plants grow well on the gently sloping Blount, Digby, Haskins, McGary, and Glynwood soils, but these soils are subject to erosion if the plant cover is damaged by overgrazing. Severe soil compaction occurs if livestock are allowed to trample the Blount, McGary, or Glynwood soils during wet periods.

The Defiance, Genesee, Shoals, and Sloan soils on flood plains are well suited to permanent pasture because they are fertile and have a moderate or high available water capacity. Flooding during the growing season would damage grain crops but would be much less damaging to permanent pastures. Surface and subsurface drains are needed to remove excess water in areas of the somewhat poorly drained and very poorly drained soils, particularly if legumes are grown. These drains generally are not needed on the well drained Genesee soils.

Good management is needed before permanent pasture can be highly productive. Lime and fertilizer should be applied at rates indicated by soil tests. Controlling weeds by periodic clipping and by applying recommended herbicides encourages the growth of desirable pasture plants. Proper seeding rates and controlled grazing help to keep well established permanent pastures in good condition. The latest information about seeding mixtures, herbicide treatment, and other management practices for specific soils can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

yields per acre

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

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

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

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

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

land capability classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*12*). 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 slight limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

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

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

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

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

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

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

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

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

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

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 7). 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, keep snow from blowing off the fields, and provide food and cover for wildlife.

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

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from a nursery or from local offices of the Soil Conservation Service; the Ohio Department of Natural Resources, Division of Forestry; or the Cooperative Extension Service.

Figure 7.—Windbreak on Glynwood silt loam, 2 to 6 percent slopes.

recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, 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,

Figure 7.—Windbreak on Glynwood silt loam, 2 to 6 percent slopes.

intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

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

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

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

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

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine and spruce.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are duckweed, wild millet, willow, reed canarygrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and shallow ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, 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. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

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

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

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

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

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

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

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

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

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

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

sanitary facilities

Table 12 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 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, 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 sand or gravel. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

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

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

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

water management

Table 14 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, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

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

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

soil properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

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

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 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, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection. If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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

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

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

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly

erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

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

In table 16, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 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 17.

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. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. 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 generally 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 excavations.

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

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

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

physical and chemical analyses of selected soils

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

These data were used in classifying and correlating the selected soils and in evaluating the behavior of the soils under various land uses. Among these data, five of the profiles were selected as representative of their respective series. The series names and the laboratory identification numbers are Glynwood (AG-1), Milford (AG-3), Digby (AG-5), Gallman (AG-6), and Montgomery (AG-S2).

In addition to the Auglaize County data, laboratory data are also available from nearby counties in western Ohio that have many of the same soils. All data are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio. Some of these data have been published in special studies of soils in nearby counties (*9, 15*).

engineering index test data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons for Digby, Gallman, and Milford soils are representative of the series and are described in the section "Soil series and their morphology." The pedon for Blount soils is also representative but is not described under "Soil series and their morphology." The soil samples were tested by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundations Section.

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

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

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*13*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is 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 have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aeric* identifies the subgroup that is drier than the typical great group. An example is Aeric Ochraqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Aeric Ochraqualfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series 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 (*11*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*13*). 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."

Blount series

The Blount series consists of somewhat poorly drained, slowly or moderately slowly permeable soils formed in moderately fine textured glacial till on till plains. Slope ranges from 0 to 6 percent.

Blount soils are similar to Del Rey and McGary soils and are commonly adjacent to Glynwood, Morley, and Pewamo soils. Del Rey and McGary soils formed in lacustrine material. Glynwood and Morley soils are better drained than the Blount soils and are less gray in the subsoil. Pewamo soils are in the lower positions on the landscape. They have a mollic epipedon.

Typical pedon of Blount silt loam, 2 to 6 percent slopes, 3 miles north of Wapakoneta, in Duchouquet Township; 2,500 feet west and 100 feet south of the northeast corner of sec. 16, T. 5 S., R. 6 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

B21tg—8 to 13 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) and common medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium subangular blocky structure; firm; thin continuous grayish brown (2.5Y 5/2) clay films on faces of peds; about 2 percent coarse fragments; medium acid; clear smooth boundary.

B22t—13 to 20 inches; brown (10YR 4/3) clay; common medium distinct grayish brown (2.5Y 5/2) mottles; moderate coarse subangular blocky structure; firm; thin continuous grayish brown (2.5Y 5/2) clay films on faces of peds; about 2 percent coarse fragments; very strongly acid; clear smooth boundary.

B3t—20 to 24 inches; yellowish brown (10YR 5/4) clay; common medium distinct grayish brown (2.5Y 5/2) mottles; weak coarse subangular blocky structure; firm; thin very patchy grayish brown (2.5Y 5/2) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

C1—24 to 32 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6 and 5/8) mottles; massive; firm; thin patchy coatings of free carbonates on a few vertical cleavages; about 2 percent coarse fragments; mildly alkaline; clear smooth boundary.

C2—32 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; light gray (10YR 7/2) and gray (10YR 6/1) coatings of free carbonates on a few vertical cleavages; about 3 percent coarse fragments; strong effervescence; moderately alkaline.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is medium acid to neutral. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is very strongly acid to medium acid in the upper part and neutral or mildly alkaline in the lower part. The B21 horizon is dominantly silty clay loam but is silty clay or clay in some pedons. The B22 and B3 horizons are 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 mildly alkaline or moderately alkaline.

Carlisle series

The Carlisle series consists of the very poorly drained soils formed in alluvium over organic deposits. These soils are in depressions. Permeability is moderately rapid to moderately slow. Slope is 0 to 2 percent.

Carlisle soils are similar to Muskego soils and are commonly adjacent to Montgomery soils. Montgomery soils formed in lacustrine sediments. Muskego soils formed in organic deposits over sedimentary peat.

Typical pedon of Carlisle silty clay loam, about 1 mile west of Santa Fe, in Clay Township; 1,700 feet south and 100 feet west of the northeast corner of sec. 26, T. 6 S., R. 7 E.

A1—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct brown (10YR 5/3) mottles; moderate medium granular structure; firm; many roots; neutral; abrupt smooth boundary.

IIOa1—12 to 20 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 30 percent fibers, a trace rubbed; weak fine granular structure; friable; fibers are primarily live sedge roots; few woody fragments 1/4 to 1 inch in diameter; neutral; abrupt smooth boundary.

IIOa2—20 to 40 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 20 percent fibers, a trace rubbed; massive; friable; dark reddish brown (5YR 2/2) pressed; common woody fragments 1/4 inch to 2 inches in diameter; neutral; clear smooth boundary.

IIOa3—40 to 60 inches; very dark gray (5YR 3/1), broken face, sapric material, black (5YR 2/1) rubbed; about 10 percent fibers, a trace rubbed; massive; friable; dark reddish brown (5YR 2/2) pressed; few woody fragments 1/4 inch to 2 inches in diameter; neutral.

The soils are medium acid to neutral throughout. The content of woody fragments is, by volume, less than 10 percent below the A1 horizon. The subsurface and bottom tiers have hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2.

Defiance series

The Defiance series consists of the somewhat poorly drained, slowly permeable or very slowly permeable soils on flood plains. These soils formed in fine textured alluvium. Slope is 0 to 2 percent.

Defiance soils are similar to Shoals soils and are commonly adjacent to Millgrove soils. Shoals soils are of mixed mineralogy and contain less clay throughout than the Defiance soils. Millgrove soils formed in glacial outwash. They have an argillic horizon and a mollic epipedon.

Typical pedon of Defiance silty clay, frequently flooded, about 1.5 miles south of Kossuth, in Salem Township; 2,200 feet east and 2,450 feet south of the northwest corner of sec. 1, T. 5 S., R. 4 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay; weak medium subangular blocky structure; firm; mildly alkaline; abrupt smooth boundary.

B21g—8 to 22 inches; dark grayish brown (10YR 4/2) silty clay; few fine faint very dark grayish brown

(10YR 3/2) mottles; moderate medium subangular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) coatings on faces of peds; mildly alkaline; gradual wavy boundary.

B22g—22 to 29 inches; dark gray (10YR 4/1) silty clay; few fine distinct yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) coatings on faces of peds; mildly alkaline; gradual wavy boundary.

B23g—29 to 34 inches; dark gray (10YR 4/1) silty clay; common fine distinct yellowish brown (10YR 5/6) and few fine prominent dark red (2.5YR 3/6) and strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; thin patchy dark gray (10YR 4/1) coatings on faces of peds; mildly alkaline; gradual wavy boundary.

B24g—34 to 40 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very firm; thin patchy dark gray (10YR 4/1) coatings on faces of peds; mildly alkaline; gradual wavy boundary.

B3g—40 to 50 inches; dark gray (10YR 4/1) silty clay; common fine and medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; thin patchy dark gray (10YR 4/1) coatings on faces of peds; mildly alkaline; gradual smooth boundary.

C—50 to 60 inches; dark gray (10YR 4/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; mildly alkaline.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 3. It is dominantly silty clay but ranges from clay to silty clay loam. It is mildly alkaline or neutral. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay or clay.

Del Rey series

The Del Rey series consists of somewhat poorly drained, slowly permeable soils on lake plains and till plains. These soils formed in calcareous lacustrine sediments over firm clay loam glacial till. Slope ranges from 0 to 3 percent.

Del Rey soils are similar to Blount and McGary soils and are commonly adjacent to Montgomery soils. Blount soils formed in glacial till. They have a higher content of coarse fragments in the solum than the Del Rey soils. McGary and Montgomery soils contain more clay in the subsoil than the Del Rey soils. They have lacustrine sediments throughout the substratum. Also, Montgomery soils are very poorly drained and have a mollic epipedon.

Typical pedon of Del Rey silt loam, till substratum, 0 to 3 percent slopes, about 2.5 miles south of St. Johns, in Clay Township; 1,500 feet north and 1,100 feet west of the southeast corner of sec. 17, T. 6 S., R. 7 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

B1—7 to 13 inches; light brownish gray (10YR 6/2) silty clay loam; many medium distinct brown (10YR 4/3) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; slightly acid; clear smooth boundary.

B21t—13 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; slightly acid; clear smooth boundary.

B22t—24 to 30 inches; brown (10YR 4/3) silty clay loam; common medium faint dark grayish brown (10YR 4/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; gray (10YR 5/1) coatings on faces of peds; thin patchy clay films on faces of peds; neutral; clear wavy boundary.

B23tg—30 to 40 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; gray (N 5/0) coatings on faces of peds; thin very patchy clay films on faces of peds; mildly alkaline; clear wavy boundary.

C1—40 to 44 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive with weak structural breaks; friable; thin patchy clay films on some vertical structural breaks; mildly alkaline; abrupt wavy boundary.

IIC2—44 to 60 inches; brown (10YR 4/3) clay loam; massive; firm; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 46 inches. The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The C horizon is mildly alkaline or moderately alkaline.

Digby series

The Digby series consists of somewhat poorly drained soils formed in glacial outwash on stream terraces and outwash plains and, in a few areas, on till plains. Permeability is moderate in the upper part of the solum and rapid in the lower part and in the substratum. Slope ranges from 0 to 6 percent.

Digby soils are similar to Haskins soils and are commonly adjacent to Gallman and Millgrove soils. Gallman soils are in the higher positions on the landscape and are well drained. Haskins soils formed in glacial outwash over glacial till or lacustrine sediments.

Millgrove soils are very poorly drained. They have a mollic epipedon.

Typical pedon of Digby loam, 0 to 2 percent slopes, about 1 mile south of St. Marys, in St. Marys Township; 1,700 feet east and 500 feet south of the northwest corner of sec. 15, T. 6 S., R. 4 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate medium subangular blocky structure; very friable; about 2 percent gravel; medium acid; abrupt smooth boundary.

B1—8 to 16 inches; brown (10YR 4/3) loam; common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; very friable; slightly acid; clear wavy boundary.

B21t—16 to 21 inches; brown (10YR 5/3) sandy clay loam; common coarse distinct light yellowish brown (10YR 6/4) and few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; thin continuous dark grayish brown (10YR 4/2) clay films on horizontal and vertical faces of peds; about 5 percent fine gravel; slightly acid; clear wavy boundary.

B22t—21 to 30 inches; brown (10YR 4/3) sandy clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; moderate coarse subangular blocky structure; friable; thin continuous dark grayish brown (10YR 4/2) clay films on horizontal and vertical faces of peds; about 10 percent fine gravel; mildly alkaline; gradual wavy boundary.

IIB3t—30 to 37 inches; brown (10YR 4/3) gravelly coarse sandy loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; very friable; clay bridgings on sand grains; about 20 percent fine gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

IIC—37 to 60 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand stratified with gravelly sandy loam; single grained; loose; about 30 percent fine gravel; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 48 inches. The content of gravel ranges, by volume, from 2 to 10 percent in the upper part of the solum and from 10 to 40 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is sandy clay, sandy clay loam, clay loam, or sandy loam or the gravelly analogs of these textures. Subhorizons of silty clay loam are in some pedons. The B horizon ranges from very strongly acid to slightly acid in the upper part and from slightly acid to moderately alkaline in the lower part. The C horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Digby Variant

The Digby Variant consists of somewhat poorly drained soils formed in slowly permeable, fine textured or moderately fine textured material over rapidly permeable glacial outwash. These soils are on outwash plains. Slope is 0 to 2 percent.

Digby Variant soils are commonly adjacent to Eldean and Millgrove soils. Eldean soils are well drained and do not have mottles in the subsoil. Millgrove soils are very poorly drained. They have a mollic epipedon.

Typical pedon of Digby Variant silt loam, 0 to 2 percent slopes, about 5 miles southeast of St. Johns, in Clay Township; 1,500 feet north and 500 feet west of the southeast corner of sec. 11, T. 6 S., R. 7 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate and strong medium granular structure; friable; about 1 percent coarse fragments; strongly acid; abrupt smooth boundary.

B21t—8 to 14 inches; brown (10YR 5/3) clay loam; common medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; less than 1 percent coarse fragments; slightly acid; clear wavy boundary.

B22tg—14 to 18 inches; light brownish gray (2.5Y 6/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; medium continuous grayish brown (10YR 5/2) clay films on vertical faces of peds; less than 1 percent coarse fragments; medium acid; clear wavy boundary.

B23t—18 to 30 inches; brown (10YR 5/3) clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; firm; medium continuous grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; less than 1 percent coarse fragments; neutral; clear wavy boundary.

IIB3—30 to 45 inches; yellowish brown (10YR 5/6) sandy loam; common medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; friable; slight effervescence; moderately alkaline; gradual wavy boundary.

IIC—45 to 60 inches; grayish brown (10YR 5/2) loamy sand; common medium distinct yellowish brown (10YR 5/4) mottles; single grained; loose; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 48 inches, and the depth to carbonates ranges from 20 to 44 inches. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the upper part of the B horizon, from 0 to 10 percent in the lower part, and from 0 to 40 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is strongly acid to neutral. The upper part of the B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is medium acid to neutral. The lower part has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 6. It is clay loam, clay, sandy clay loam, sandy loam, or stratified silt loam and sandy loam. It is neutral to moderately alkaline. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loamy sand, gravelly sandy loam, or sand. It is mildly alkaline or moderately alkaline.

Eldean series

The Eldean series consists of well drained soils formed in glacial outwash on stream terraces, on outwash plains, and in outwash areas on end moraines. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 12 percent.

Eldean soils are similar to Gallman soils and are commonly adjacent to Glynwood and Morley soils. Gallman soils contain less clay in the subsoil than the Eldean soils and have a thicker solum. Glynwood and Morley soils formed in glacial till.

Typical pedon of Eldean loam, 2 to 6 percent slopes, about 2 miles east of St. Johns, in Clay Township; 1,100 feet south and 400 feet west of the northeast corner of sec. 4, T. 6 S., R. 7 E.

Ap—0 to 8 inches; dark brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; about 4 percent gravel; neutral; abrupt smooth boundary.

B21t—8 to 17 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin patchy dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; strongly acid; clear wavy boundary.

B22t—17 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; about 2 percent gravel; slightly acid; clear wavy boundary.

B23t—27 to 34 inches; brown (10YR 4/3) gravelly clay loam; weak coarse prismatic structure; friable; about 20 percent gravel; neutral; clear irregular boundary.

B3—34 to 40 inches; brown (10YR 4/3) gravelly clay loam; weak coarse prismatic structure; friable; many medium white (10YR 8/1) and light gray (10YR 7/2) remnants of limestone pebbles; about 30 percent gravel; slight effervescence; mildly alkaline; gradual irregular boundary.

C—40 to 60 inches; dark yellowish brown (10YR 4/4) very gravelly coarse sandy loam; massive; very friable; about 55 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 40 inches, and the depth to carbonates ranges from 22 to 38 inches. The content of gravel ranges, by volume, from 2 to 10 percent in the A horizon and the upper part of the B horizon and from 12 to 60 percent in the lower part of the B horizon and in the C horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 2 or 3. It is loam or silt loam. It is strongly acid to neutral. The B horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 or 4. The B2 horizon is clay loam, sandy clay, or clay or the gravelly analogs of these textures. It is strongly acid to neutral. The B3 horizon is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is very gravelly coarse sandy loam to gravelly sand and in some pedons has strata of silt loam.

Gallman series

The Gallman series consists of well drained, moderately rapidly permeable soils formed in poorly sorted glacial outwash on stream terraces. Slope ranges from 2 to 6 percent.

Gallman soils are similar to Eldean soils and are commonly adjacent to Digby, Glynwood, and Morley soils. Digby soils are somewhat poorly drained and have low chroma mottles in the subsoil. Eldean soils contain more clay in the subsoil than the Gallman soils and have a thinner solum. Glynwood and Morley soils formed in glacial till.

Typical pedon of Gallman loam, 2 to 6 percent slopes, about 3 miles north of Buckland, in Logan Township; 2,100 feet south and 220 feet east of the northwest corner of sec. 27, T. 4 S., R. 5 E.

Ap—0 to 8 inches; brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; about 10 percent fine gravel; neutral; abrupt smooth boundary.

B1—8 to 16 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; about 12 percent fine gravel; slightly acid; clear wavy boundary.

B21t—16 to 21 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; thin continuous dark grayish brown (10YR 4/2) clay films on horizontal faces of peds; about 10 percent fine gravel; slightly acid; clear wavy boundary.

B22t—21 to 32 inches; brown (7.5YR 4/4) sandy clay loam; moderate coarse subangular blocky structure; friable; thin patchy dark grayish brown (10YR 4/2) clay films on horizontal and vertical faces of peds; about 10 percent fine gravel; slightly acid; clear wavy boundary.

B23t—32 to 39 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam; moderate medium angular blocky structure; friable; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; about 20 percent fine gravel; slightly acid; gradual wavy boundary.

B31t—39 to 45 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; clay bridgings on some sand grains and on some pebbles; about 10 percent fine gravel; slightly acid; gradual wavy boundary.
B32t—45 to 53 inches; brown (10YR 4/3) sandy clay loam; massive; friable; clay bridgings on some sand grains and on some pebbles; about 10 percent fine gravel; neutral; gradual wavy boundary.
B33t—53 to 68 inches; brown (10YR 5/3) sandy clay loam; massive; friable; clay bridgings on some sand grains and on some pebbles; about 10 percent fine gravel; neutral; gradual irregular boundary.
C—68 to 81 inches; dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) coarse sandy loam; single grained; loose; about 10 percent fine gravel; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 60 to 90 inches. The content of fine and medium gravel ranges, by volume, from 5 to 30 percent in the upper part of the B horizon and from 5 to 40 percent in the lower part.

The Ap horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 5. It is loam, sandy clay loam, clay loam, or sandy loam or the gravelly analogs of these textures. It is very strongly acid to slightly acid in the upper part and medium acid to mildly alkaline in the lower part. The C horizon is coarse sandy loam or loamy sand or the gravelly analogs of these textures.

Genesee series

The Genesee series consists of well drained, moderately permeable soils on the highest parts of flood plains. These soils formed in loamy recent alluvium that washed in mainly from surrounding uplands. Slope is 0 to 2 percent.

Genesee soils are commonly adjacent to Shoals and Sloan soils. The adjacent soils are less well drained than the Genesee soils and are lower on the flood plains. Also, Sloan soils have a mollic epipedon.

Typical pedon of Genesee silt loam, occasionally flooded, about 2 miles north of Buckland, in Logan Township; 600 feet south and 900 feet east of the northwest corner of sec. 35, T. 4 S., R. 5 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate coarse granular structure; friable; mildly alkaline; abrupt smooth boundary.
B1—8 to 26 inches; dark brown (10YR 4/3) silt loam; weak coarse subangular blocky structure; firm; mildly alkaline; clear wavy boundary.
B2—26 to 32 inches; dark yellowish brown (10YR 4/4) silt loam; moderate coarse subangular blocky structure; friable; slight effervescence; moderately alkaline; clear wavy boundary.
B3—32 to 40 inches; dark brown (10YR 4/3) loam; moderate medium subangular blocky structure; very friable; slight effervescence; moderately alkaline; clear wavy boundary.
C1—40 to 46 inches; dark brown (10YR 4/3) loam; weak coarse subangular blocky structure; very friable; few snail shells; some dark brown (10YR 3/3) coatings on faces of peds; slight effervescence; moderately alkaline; clear wavy boundary.
C2—46 to 60 inches; dark brown (10YR 4/3) clay loam; few fine dark grayish brown (10YR 4/2) mottles; massive; very friable; few snail shells; slight effervescence; moderately alkaline.

The depth to free carbonates ranges from 18 to 32 inches. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The B horizon has hue of 10YR and value and chroma of 3 or 4. It is silt loam in the upper part and loam or fine sandy loam in the lower part. The C horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is loam, sand, clay loam, gravelly sandy loam, or gravelly silt loam.

Glynwood series

The Glynwood series consists of moderately well drained, slowly permeable soils on ground and end moraines. These soils formed in calcareous clay loam or silty clay loam glacial till. Slope ranges from 2 to 6 percent.

Glynwood soils are commonly adjacent to Blount, Morley, and Pewamo soils. They are also near Eldean soils in some areas. Blount soils are somewhat poorly drained and have lower chroma in the upper part of the subsoil than the Glynwood soils. Eldean soils formed in glacial outwash. Pewamo soils have a mollic epipedon. Morley soils are well drained and do not have mottles with chroma of 2 or less in the upper 10 inches of the argillic horizon.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, about 5 miles northeast of St. Marys and 1 mile north of Glynwood, in Moulton Township; 500 feet east and 900 feet north of the southwest corner of sec. 17, T. 5 S., R. 5 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; few fine dark concretions (iron and manganese oxide); slightly acid; abrupt smooth boundary.
A2—7 to 9 inches; brown (10YR 4/3) silt loam; few fine faint yellowish brown (10YR 5/6) mottles; weak very thin platy structure; friable; few fine dark concretions (iron and manganese oxide); many worm casts; slightly acid; abrupt wavy boundary.
B1—9 to 12 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; weak medium prismatic structure parting to moderate medium and

fine subangular blocky; firm; thick continuous pale brown (10YR 6/3) and brown (10YR 5/3) silty coatings; medium acid; clear smooth boundary.

IIB2t—12 to 23 inches; dark yellowish brown (10YR 4/4) clay; few fine prominent strong brown (7.5YR 5/8) and common fine distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to strong medium and coarse angular blocky; firm; many fine dark concretions (iron and manganese oxide); medium patchy brown (10YR 5/3) silty coatings; thin continuous dark brown (10YR 3/3) clay films; few pebbles; strongly acid in the upper part, grading to neutral in the lower part; clear wavy boundary.

IIB3t—23 to 32 inches; yellowish brown (10YR 5/4) clay loam; common fine faint yellowish brown (10YR 5/6) mottles; weak very coarse prismatic structure parting to weak coarse subangular blocky; firm; many fine dark concretions (iron and manganese oxide); thick patchy brown (10YR 4/3) clay films; thick pale brown (10YR 6/3) coatings of free carbonates on vertical faces of peds; less than 5 percent pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

IIC—32 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct strong brown (7.5YR 5/6 and 5/8) mottles; massive; very firm; few fine dark concretions (iron and manganese oxide); pale brown (10YR 6/3) and gray (5Y 5/1) coatings of free carbonates on some cleavage planes; less than 5 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches, and the depth to carbonates ranges from 16 to 36 inches. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the A horizon and from 1 to 10 percent in the IIB horizon. Reaction ranges from medium acid to neutral in the A horizon, from very strongly acid to neutral in the upper part of the B horizon, and from slightly acid to moderately alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay, clay, silty clay loam, or clay loam. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is clay loam or silty clay loam.

Haskins series

The Haskins series consists of somewhat poorly drained soils on stream terraces and end and ground moraines. These soils formed in loamy outwash over loamy or clayey glacial till or lacustrine sediments. Permeability is moderate in the outwash material and slow or very slow in the glacial till or lacustrine sediments. Slope ranges from 0 to 6 percent.

Haskins soils are similar to Digby soils and are commonly adjacent to Blount and Pewamo soils. Blount and Pewamo soils formed in glacial till. They contain more clay in the argillic horizon than the Haskins soils. Also, Pewamo soils are very poorly drained and have a mollic epipedon. Digby soils formed in glacial outwash.

Typical pedon of Haskins loam, 2 to 6 percent slopes, about 1 mile southwest of Kossuth, in Salem Township; 900 feet west and 650 feet north of the southeast corner of sec. 35, T. 4 S., R. 4 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate medium and coarse granular structure; friable; less than 5 percent fine gravel; strongly acid; abrupt smooth boundary.

B1—8 to 11 inches; brown (10YR 5/3) fine sandy loam; common coarse distinct light brownish gray (10YR 6/2) and few medium distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; about 2 percent fine gravel; very strongly acid; clear wavy boundary.

B21—11 to 20 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many coarse distinct light brownish gray (10YR 6/2) and common medium distinct strong brown (7.5YR 5/6) mottles; strong medium and coarse subangular blocky structure; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; about 2 percent fine gravel; very strongly acid; clear wavy boundary.

B22t—20 to 26 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium distinct gray (10YR 6/1) and common medium distinct strong brown (7.5YR 5/6) mottles; strong medium subangular blocky structure; firm; thin continuous dark gray (10YR 4/1) clay films on faces of peds; about 2 percent fine gravel; very strongly acid; clear wavy boundary.

B23t—26 to 35 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium distinct gray (10YR 6/1) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin continuous dark gray (10YR 4/1) clay films on faces of peds; about 2 percent fine gravel; strongly acid; clear wavy boundary.

IIB3t—35 to 50 inches; brown (10YR 4/3) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse prismatic structure; very firm; light gray (10YR 6/1) silt coatings on vertical faces of peds; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC—50 to 60 inches; brown (10YR 4/3) clay loam; massive; very firm; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 50 inches. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is strongly acid to neutral. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is clay loam, fine sandy loam, or sandy clay loam or the gravelly analogs of these textures. It ranges from very strongly acid to medium acid in the upper part and from strongly acid to moderately alkaline in the lower part. The C horizon is silty clay, clay loam, or clay.

Latty series

The Latty series consists of very poorly drained, very slowly permeable soils formed in lake-laid sediments on lake plains. Slope is 0 to 2 percent.

Latty soils are similar to Milford and Montgomery soils and are commonly adjacent to Millgrove soils. Milford, Millgrove, and Montgomery soils have a mollic epipedon. Milford soils contain less clay in the lower part of the subsoil and in the substratum than the Latty soils. Millgrove soils formed mainly in moderately fine textured glacial outwash overlying stratified sandy, gravelly, and loamy deposits of varying thickness.

Typical pedon of Latty silty clay, about 1.5 miles north of Santa Fe, in Clay Township; 1,300 feet west and 200 feet north of the southeast corner of sec. 13, T. 6 S., R. 7 E.

Ap—0 to 8 inches; dark gray (10YR 4/1) silty clay; moderate medium subangular blocky structure; firm; neutral; abrupt smooth boundary.

B1g—8 to 14 inches; dark grayish brown (10YR 4/2) silty clay; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; grayish brown (10YR 5/2) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B21g—14 to 20 inches; grayish brown (2.5Y 5/2) clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B22g—20 to 32 inches; gray (10YR 5/1) clay; common medium distinct brown (10YR 4/3) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; mildly alkaline; clear wavy boundary.

B3g—32 to 45 inches; light brownish gray (10YR 6/2) clay; many medium distinct brownish yellow (10YR 6/6) and common coarse distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; firm; mildly alkaline; clear wavy boundary.

Cg—45 to 60 inches; grayish brown (10YR 5/2) clay; massive; firm; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 48 inches. The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is slightly acid or neutral. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is commonly stratified clay or silty clay.

McGary series

The McGary series consists of somewhat poorly drained, slowly or very slowly permeable soils. These soils formed in lacustrine sediments on flats and slight rises on old shallow glacial lakes. Slope ranges from 0 to 4 percent.

McGary soils are similar to Blount and Del Rey soils and are commonly adjacent to Montgomery and Latty soils. Blount and Del Rey soils are of illitic mineralogy. Blount soils formed in glacial till. Del Rey soils contain less clay in the subsoil than the McGary soils. Montgomery and Latty soils are very poorly drained. Also, Montgomery soils have a mollic epipedon.

Typical pedon of McGary silt loam, 0 to 4 percent slopes, about 2 miles west of Santa Fe, in Clay Township; 600 feet north and 160 feet west of the southeast corner of sec. 22, T. 6 S., R. 7 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

B1tg—8 to 16 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct brown (10YR 4/3) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; thin patchy gray (10YR 6/1) clay films on faces of peds; slightly acid; clear wavy boundary.

B21t—16 to 25 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct gray (10YR 6/1) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds and lining root channels; few fine black (10YR 2/1) concretions (iron and manganese oxide); neutral; clear wavy boundary.

B22t—25 to 29 inches; brown (10YR 4/3) silty clay loam; common medium distinct grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

B3t—29 to 35 inches; dark yellowish brown (10YR 4/4) silty clay; weak fine prismatic structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

C1—35 to 40 inches; yellowish brown (10YR 5/6) silty clay; common fine distinct gray (10YR 5/1) and grayish brown (10YR 5/2) mottles; massive; firm;

strong effervescence; moderately alkaline; clear wavy boundary.

C2—40 to 60 inches; dark yellowish brown (10YR 4/4) silty clay; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 36 inches. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. If limed, it is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is silty clay or silty clay loam. The B horizon ranges from medium acid to neutral in the upper part and is neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. It is silty clay or clay.

Milford series

The Milford series consists of very poorly drained, moderately slowly permeable soils formed in glacial lakebed sediments on lake plains. Slope is 0 to 2 percent.

Milford soils are commonly adjacent to Montgomery and Pewamo soils. Montgomery soils contain more clay in the lower part of the solum and in the substratum than the Milford soils. Pewamo soils formed in glacial till on till plains.

Typical pedon of Milford silty clay, about 3.5 miles east of New Hampshire, in Goshen Township; 4,150 feet north and 1,050 feet west of the intersection of the Hardin County line and State Route 385:

Ap—0 to 10 inches; very dark brown (10YR 2/2) silty clay; moderate very coarse granular structure; firm; medium acid; abrupt smooth boundary.

B21g—10 to 14 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to strong fine angular blocky; very firm; slightly acid; clear smooth boundary.

B22g—14 to 22 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to medium angular blocky; very firm; slightly acid; gradual smooth boundary.

B23g—22 to 30 inches; gray (10YR 5/1) silty clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate coarse angular blocky; very firm; neutral; clear wavy boundary.

B23—30 to 40 inches; yellowish brown (10YR 5/6) silty clay loam; coarse prominent gray and light gray (N 6/0) mottles; weak coarse subangular blocky structure parting to fine subangular blocky; firm; slight effervescence; mildly alkaline; gradual wavy boundary.

B3g—40 to 53 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; very firm; slight effervescence; mildly alkaline; gradual wavy boundary.

C—53 to 60 inches; dark gray (10YR 4/1) silty clay loam; few coarse distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse platy structure; firm; slight effervescence; mildly 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 A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is medium acid to neutral. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 6. It is silty clay or silty clay loam in the upper part and silty clay loam in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam or loam and in some pedons has thin strata of silt loam and sandy loam.

Millgrove series

The Millgrove series consists of very poorly drained, moderately permeable soils in low lying areas on stream terraces and outwash plains. These soils formed in moderately fine textured and medium textured glacial outwash over calcareous sandy, gravelly, and loamy deposits. Slope is 0 to 2 percent.

Millgrove soils are commonly adjacent to Digby, Digby Variant, and Eldean soils. The adjacent soils are better drained than the Millgrove soils. They have an ochric epipedon.

Typical pedon of Millgrove clay loam, about 4 miles southeast of St. Johns, in Clay Township; 1,800 feet south and 700 feet west of the northeast corner of sec. 11, T. 6 S., R. 7 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; firm; many roots; about 1 percent coarse fragments; neutral; abrupt smooth boundary.

B21tg—11 to 19 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/4) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; common roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; about 1 percent coarse fragments; neutral; clear smooth boundary.

B22tg—19 to 27 inches; gray (10YR 5/1) clay loam; common medium distinct yellowish brown (10YR 5/6) and common fine distinct yellowish brown (10YR 5/8) mottles; weak medium prismatic structure parting to strong medium angular blocky; firm; common roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; about 3 percent coarse fragments; common very dark grayish brown (10YR 3/2) krotovinas 1 to 2 inches in diameter; mildly alkaline; gradual wavy boundary.

B31g—27 to 33 inches; gray (10YR 5/1) loam; common medium distinct yellowish brown (10YR 5/6 and 5/4) mottles; many fine light gray (10YR 7/2) weathered limestone remnants; weak coarse angular blocky structure; friable; few roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; about 5 percent coarse fragments; common very dark grayish brown (10YR 3/2) krotovinas 1 to 2 inches in diameter; slight effervescence; mildly alkaline; gradual wavy boundary.

B32g—33 to 39 inches; dark grayish brown (2.5Y 4/2) loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse angular blocky structure; friable; few roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; about 10 percent coarse fragments; 3-inch pockets of yellowish brown (10YR 5/8) material; strong effervescence; mildly alkaline; abrupt wavy boundary.

C1g—39 to 51 inches; gray (10YR 5/1) gravelly sandy loam; massive; very friable; about 30 percent coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2g—51 to 60 inches; dark grayish brown (2.5Y 4/2) sand; single grained; loose; about 2 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 28 to 50 inches. The content of gravel ranges, by volume, from 1 to 10 percent in the upper part of the solum and from 2 to 50 percent in the lower part.

The mollic epipedon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It ranges from 10 to 17 inches in thickness. It is medium acid to neutral. The part of the Bg horizon below the mollic epipedon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is clay loam, loam, or sandy clay loam or the gravelly analogs of these textures. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is stratified sandy loam, loamy sand, or sand or the gravelly analogs of these textures and in some pedons has subhorizons of clay loam in the upper part.

Montgomery series

The Montgomery series consists of very poorly drained, slowly or very slowly permeable soils formed in lake-laid sediments on lake plains. Slope is 0 to 2 percent.

Montgomery soils are similar to Milford and Latty soils and are commonly adjacent to McGary, Del Rey, Pewamo, and Millgrove soils. Del Rey and McGary soils are somewhat poorly drained. They have an ochric epipedon. Latty soils also have an ochric epipedon. Milford soils contain less clay in the lower part of the solum and in the substratum than the Montgomery soils. Millgrove soils formed mainly in moderately fine textured glacial outwash overlying stratified sandy, gravelly, and loamy deposits of varying thickness. Pewamo soils formed in glacial till on till plains.

Typical pedon of Montgomery silty clay, about 6.5 miles southeast of Wapakoneta, in Clay Township; 1,370 feet north and 200 feet west of the southeast corner of sec. 18, T. 6 S., R. 7 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay; moderate medium and coarse granular structure; friable; neutral; clear smooth boundary.

B1g—8 to 17 inches; very dark gray (10YR 3/1) silty clay; few medium distinct yellowish brown (10YR 5/6) mottles; moderate fine angular blocky structure; firm; neutral; gradual irregular boundary.

B2g—17 to 24 inches; gray (10YR 5/1) silty clay; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; neutral; gradual irregular boundary.

B3g—24 to 42 inches; gray (10YR 5/1) silty clay; many medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to moderate coarse subangular blocky; very firm; slight effervescence; mildly alkaline; clear wavy boundary.

C—42 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam; many coarse distinct light olive brown (2.5Y 5/6) mottles; massive; firm; strong effervescence; mildly alkaline.

The solum ranges from 30 to 47 inches in thickness. It is slightly acid or neutral in the upper part and slightly acid to mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The part of the B horizon below the mollic epipedon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon is silty clay, clay, or silty clay loam and in some pedons has thin strata of silt loam.

Morley series

The Morley series consists of well drained, slowly permeable soils on end moraines and dissected parts of ground moraines. These soils formed in calcareous loamy glacial till. Slope ranges from 6 to 18 percent.

Morley soils are commonly adjacent to the Blount, Glynwood, and Pewamo soils. The adjacent soils are not so well drained as the Morley soils and have low chroma mottles in the subsoil. Also, Pewamo soils have a mollic epipedon.

Typical pedon of Morley clay loam, 6 to 12 percent slopes, eroded, about 2 miles northwest of Waynesfield, in Union Township; 250 feet north and 100 feet east of the southwest corner of sec. 12, T. 5 S., R. 7 E.

Ap—0 to 4 inches; brown (10YR 4/3) clay loam; weak fine granular structure; firm; about 3 percent coarse fragments; slightly acid; abrupt smooth boundary.

B21t—4 to 11 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; about 3 percent coarse fragments; slightly acid; clear wavy boundary.

B22t—11 to 20 inches; dark yellowish brown (10YR 4/4) clay; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin very patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; about 6 percent coarse fragments; neutral; gradual wavy boundary.

B23t—20 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin very patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; about 6 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

B3t—27 to 34 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on vertical faces of peds; white (10YR 8/1) coatings of free carbonates; strong effervescence; moderately alkaline; diffuse wavy boundary.

C—34 to 60 inches; brown (10YR 4/3) clay loam; common fine faint brown (10YR 5/3) mottles; massive; very firm; white (10YR 8/1) coatings of free carbonates; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 42 inches. The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid or slightly acid. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, clay, or silty clay loam. It is strongly acid to neutral in the upper part and neutral to moderately alkaline in the lower part. The C horizon is clay loam or silty clay loam.

Muskego series

The Muskego series consists of very poorly drained soils formed in organic deposits over sedimentary peat in depressions on outwash plains and till plains. Permeability is moderately slow to moderately rapid in the organic deposits and slow in the sedimentary peat. Slope is less than 2 percent.

Muskego soils are similar to Carlisle soils. These similar soils formed in organic deposits that are thicker than those in which the Muskego soils formed and do not have sedimentary peat in the lower part.

Typical pedon of Muskego muck, about 1.75 miles south of St. Johns, in Clay Township; 1,400 feet north and 400 feet east of the southwest corner of sec. 8, T. 6 S., R. 7 E.

Oa1—0 to 8 inches; black (10YR 2/1), broken face and rubbed, sapric material; no fiber rubbed or unrubbed; weak medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

Oa2—8 to 22 inches; black (10YR 2/1), broken face, sapric material, black (N 2/0) rubbed; less than 5 percent fiber, none rubbed; weak medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

Lco1—22 to 32 inches; black (10YR 2/1), broken face and rubbed, sedimentary peat; about 5 percent fiber, none rubbed; moderate coarse granular structure; slightly sticky; mildly alkaline; abrupt smooth boundary.

Lco2—32 to 38 inches; very dark grayish brown (2.5Y 3/2), broken face and rubbed, sedimentary peat; about 10 percent fiber, none rubbed; weak coarse granular structure; slightly sticky; mildly alkaline; clear smooth boundary.

Lco3—38 to 60 inches; dark gray (5Y 4/1), broken face and rubbed, sedimentary peat; about 5 percent fiber, none rubbed; weak medium platy structure; slightly sticky; common fine snail shells; strong effervescence; moderately alkaline.

The depth to coprogenous earth ranges from 16 to 26 inches. The surface tier has hue of 10YR, value of 2, and chroma of 1 or 2. It is medium acid to mildly alkaline. The Lco horizon has hue of 10YR to 5Y, value of 2 to 5, and chroma of 1 or 2.

Pewamo series

The Pewamo series consists of very poorly drained, moderately slowly permeable soils on till plains. These soils formed in calcareous loamy glacial till. Slope is 0 to 2 percent.

Pewamo soils are commonly adjacent to Blount, Glynwood, Montgomery, and Morley soils. Blount, Glynwood, and Morley soils are in the higher positions on the landscape. They have an ochric epipedon. Montgomery soils formed in lakebed sediments. They do not have an argillic horizon.

Typical pedon of Pewamo silty clay loam, about 4 miles northwest of St. Marys, in Noble Township; 1,400 feet south and 200 feet east of the northwest corner of sec. 19, T. 5 S., R. 4 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam; weak fine and medium subangular blocky structure; firm; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A12—8 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam; common fine and medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; thin patchy dark gray (10YR 4/1) coatings on vertical and horizontal faces of peds; about 2 percent coarse fragments; slightly acid; clear smooth boundary.

B1tg—12 to 22 inches; grayish brown (10YR 5/2) silty clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; strong medium angular blocky structure; very firm; thin continuous dark gray (10YR 4/1) clay films on vertical faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

B21tg—22 to 30 inches; grayish brown (10YR 5/2) clay; common fine distinct dark yellowish brown (10YR 4/4), few fine faint gray (10YR 5/1), and many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very firm; thin continuous gray (10YR 5/1) clay films on vertical faces of peds; about 2 percent coarse fragments; neutral; gradual wavy boundary.

B22tg—30 to 53 inches; gray (10YR 5/1) clay; few fine distinct yellowish brown (10YR 5/6) and common fine and medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; very firm; thin patchy gray (10YR 5/1) clay films on horizontal and vertical faces of peds; about 5 percent coarse fragments; neutral in the upper part and mildly alkaline in the lower part; gradual wavy boundary.

B3tg—53 to 58 inches; grayish brown (10YR 5/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; very firm; few roots; thin patchy gray (10YR 5/1) clay films on vertical faces of peds; about 4 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C—58 to 60 inches; gray (10YR 5/1) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; very firm; about 8 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 29 to 70 inches. The depth to carbonates ranges from 29 to 60 inches. The content of coarse fragments ranges, by volume, from 1 to 10 percent throughout the solum. The mollic epipedon is 10 to 14 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 5Y to 10YR, value of 4 or 5, and chroma of 1 or 2. It is clay, silty clay, or clay loam. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is clay loam or silty clay loam. It is mildly alkaline or moderately alkaline.

Shoals series

The Shoals series consists of somewhat poorly drained, moderately permeable soils on flood plains. These soils formed mainly in recent loamy alluvium that washed in from surrounding uplands. Slope is 0 to 2 percent.

Shoals soils are commonly adjacent to Genesee and Sloan soils and are similar to Defiance soils. Defiance soils contain more clay in the subsoil than the Shoals soils and are of illitic mineralogy. Genesee soils are well drained and are on the higher parts of the flood plains. Sloan soils are very poorly drained and are on the lower parts of the flood plains. They have a mollic epipedon.

Typical pedon of Shoals silt loam, occasionally flooded, about 11 miles northeast of St. Marys, in Logan Township; 800 feet north and 2,000 feet east of the southwest corner of sec. 22, T. 4 S., R. 5 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

C1—8 to 14 inches; brown (10YR 5/3) silt loam; few fine faint grayish brown (10YR 5/2) mottles; moderate medium granular structure; friable; neutral; clear smooth boundary.

C2—14 to 26 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

C3—26 to 32 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

C4—32 to 40 inches; dark grayish brown (10YR 4/2) loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

C5—40 to 60 inches; brown (10YR 5/3) sandy loam; many coarse faint grayish brown (10YR 5/2) mottles; massive; friable; slight effervescence; mildly alkaline.

The Ap horizon is slightly acid to mildly alkaline. The part of the C horizon within a depth of 40 inches has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam, loam, clay loam, or silty clay loam. It is neutral or mildly alkaline. The part below a depth of 40 inches has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is commonly stratified with silt loam and sandy loam, becoming coarser textured with increasing depth.

Sloan series

The Sloan series consists of very poorly drained soils formed in recent loamy alluvium on flood plains. Permeability is moderate or moderately slow. Slope is 0 to 2 percent.

Sloan soils are commonly adjacent to Genesee and Shoals soils. The adjacent soils have an ochric epipedon. They are better drained than the Sloan soils and are not dominated by low chroma colors in the subsoil.

Typical pedon of Sloan silty clay loam, frequently flooded, about 11.5 miles northeast of St. Marys, in Logan Township; 800 feet south and 1,700 feet west of the northeast corner of sec. 22, T. 4 S., R. 5 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium subangular blocky structure; firm; slightly acid; abrupt smooth boundary.

A12—10 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; neutral; gradual smooth boundary.

B21g—14 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine distinct dark yellowish brown (10YR 3/4) mottles; strong medium angular blocky structure; firm; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; gradual wavy boundary.

B22g—20 to 28 inches; dark grayish brown (10YR 4/2) silty clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; neutral; gradual wavy boundary.

B23g—28 to 34 inches; dark grayish brown (10YR 4/2) clay loam; few medium distinct yellowish brown (10YR 5/6) and few fine faint very dark grayish brown (10YR 3/2) mottles; weak medium subangular blocky structure; firm; mildly alkaline; gradual wavy boundary.

IIC1g—34 to 40 inches; dark grayish brown (10YR 4/2) sandy clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium faint dark gray (10YR 4/1) mottles; massive; firm; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC2g—40 to 60 inches; dark gray (10YR 4/1) sandy loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; strong effervescence; moderately alkaline.

The Ap horizon is slightly acid to mildly alkaline. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, clay loam, or loam. It is neutral or mildly alkaline in the upper part and mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is stratified clay loam, sandy loam, or sandy clay loam or the gravelly analogs of these textures.

formation of the soils

Richard L. Christman, Ohio Department of Natural Resources, Division of Lands and Soil, prepared this section.

Soils form through the physical and chemical weathering of deposited or accumulated geologic material. The important factors in soil formation are parent material, climate, living organisms, topography, and time.

Climate, living organisms, and vegetation are the active factors in soil formation. Their effect on the parent material is modified by topography and by the length of time that the parent material has been acted upon. The relative importance of each factor differs from place to place. In some areas one factor dominates and is responsible for most of the soil properties, but in most areas the interaction of all five factors determines the kind of soil that forms.

parent material

The parent material in Auglaize County is dominantly of glacial origin. It includes glacial till, alluvium, lacustrine sediments, loess, and outwash deposits.

Glacial drift, a general term that refers to till and outwash sand and gravel, is the most extensive parent material in the county. The Morley, Glynwood, Blount, and Pewamo soils formed in weathered till. The till generally is homogenous and uniform in texture, and the soils that formed in this parent material have a fairly uniform, fine textured and moderately fine textured subsoil. Partly because of a thin layer of loess over the glacial till, the surface layer of Blount, Glynwood, and other soils is silty.

Outwash sand and gravel were deposited by melt water along glacial streams in the county. The Gallman, Eldean, and similar soils formed in this material. Dark brown and brown colors became evident as the parent material of these soils weathered. Haskins soils formed in a thin mantle of outwash underlain with glacial till. The Millgrove and Digby soils are grayer than other soils formed in glacial outwash because drainage is restricted and aeration is poor.

Lacustrine material, or old sediments on lake bottoms, is in small areas throughout the county and in a large area in the eastern part of the county. The large area is in the Milford association, which is described under the heading "General soil map units." The Milford, Montgomery, and McGary soils formed in the stratified clays and silts that are characteristic of these areas.

Floodwater deposits are the youngest parent material in the county. These materials accumulate when fresh sediments are added by stream overflow. The sediments are from the surface layer of higher lying soils on uplands. The Genesee, Shoals, and Sloan soils formed in moderately coarse textured to moderately fine textured alluvium on first bottoms. The Defiance soils formed in fine textured and moderately fine textured sediments on first bottoms.

climate

The climate of Auglaize County has favored physical change and chemical weathering of parent material and biological activity.

Rainfall has been abundant enough for percolation to leach carbonates to a moderate depth in Blount, Glynwood, and other soils. It has been frequent enough for wetting and drying cycles to favor the translocation of clay minerals and the formation of soil structure in Glynwood and Blount soils.

The range in temperature variations has favored both physical change and chemical weathering of parent material. Freezing and thawing have aided in the formation of soil structure. Warm summer temperatures have favored chemical reactions in the weathering of primary minerals.

Both rainfall and temperature have promoted plant growth and the resulting moderate or high organic matter content in Blount, Montgomery, and similar soils.

living organisms

In Auglaize County the vegetation at the time of settlement was hardwood forests. The common trees were probably beech, maple, oak, ash, and elm. Also evident were grassy clearings on the better drained sites and marshy openings in the poorly drained swales. Nearly level and gently sloping soils formed in forested areas are naturally acid and have a lighter colored surface layer than those that formed in swales. Examples are the Blount, Glynwood, and Morley soils. The Pewamo, Montgomery, Milford, and Millgrove soils are in the marshy swales.

Small animals, insects, worms, and roots channel the soil and make it more rapidly permeable. Animals also mix the soil material and contribute organic matter. Crawfish channels are most prevalent in the very poorly drained soils, such as the Pewamo, Millgrove, Milford, and Montgomery soils.

Management is influencing future soil formation in many areas through artificial drainage of wet soils; irrigation of dry soils; changes in the dominant vegetation; applications of lime and fertilizer, which affect soil chemistry; and transportation or removal of soil.

topography

Topography helps to account for the formation of different kinds of soil from the same kind of parent material, as is illustrated by comparing Morley, Glynwood, Blount, and Pewamo soils, all of which formed in glacial till. The well drained Morley soils and the moderately well drained Glynwood soils are in gently sloping to moderately steep areas where runoff is medium to very rapid. The nearly level and gently sloping, somewhat poorly drained Blount soils formed in areas where runoff is slow and medium. Nearby, the nearly level, very poorly drained, darker Pewamo soils formed in swales and in other areas where organic residue accumulated because of a seasonal high water table. Organic soils, such as Carlisle and Muskego, formed in the depressional areas where water was ponded for many years in the postglacial period and the wet vegetation resulted in an accumulation of organic matter.

time

The length of time that the parent material has been exposed to the active forces of climate and vegetation is an important factor in soil formation. It has influenced the degree of weathering of minerals and the formation of soil structure.

All of the glacial till and outwash material in the county has weathered for about the same amount of time. Differences in soils, therefore, are caused mainly by differences in microclimate, topography, and vegetation. The Genesee, Shoals, and other soils on flood plains constantly receive new floodwater deposits. Thus, they have had little chance to develop horizons other than those in which organic matter accumulates.

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glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

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.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

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.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

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.

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, compact layers to depths 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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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 all or part of the 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.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

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. The Lco horizon is a limnic layer that contains many fecal pellets.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

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 removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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 capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

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.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are end, terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

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.

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 runoff water.

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.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

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.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure 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 (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile 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 (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

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.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

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 of size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.