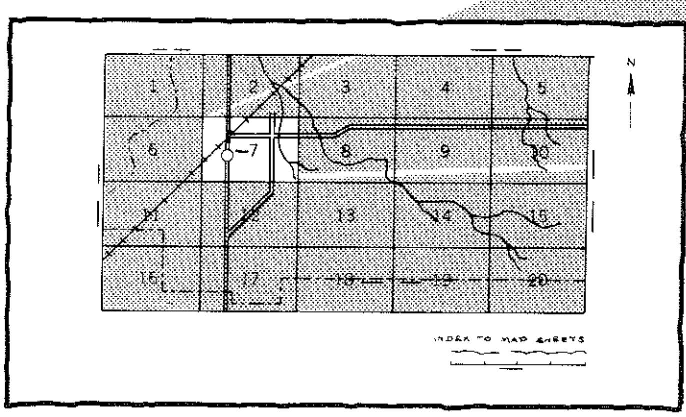
SOIL SURVEY of

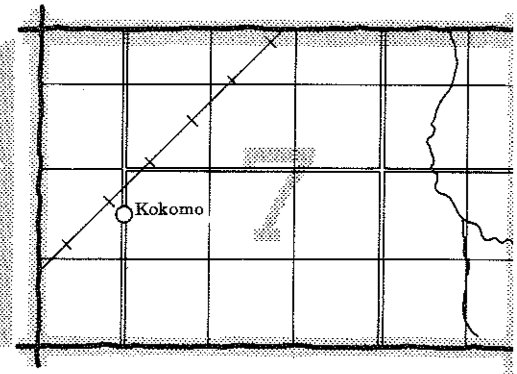
SENECA COUNTY, OHIO

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

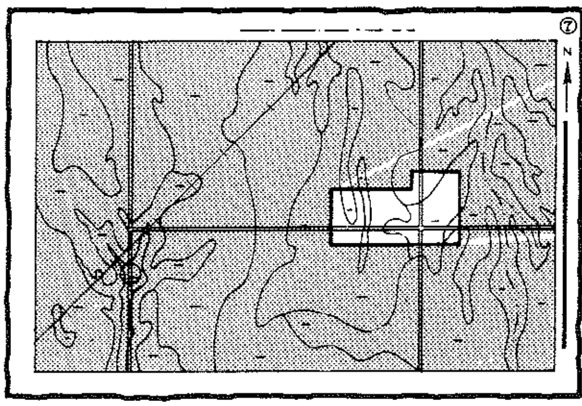
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

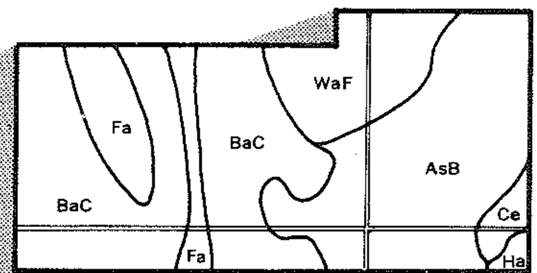




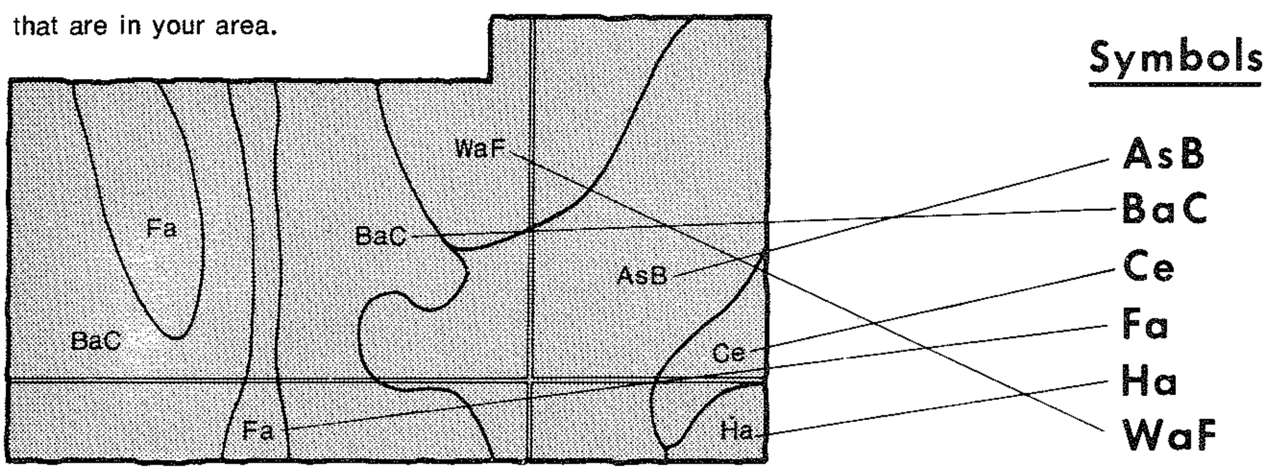
2. Note the number of the map sheet and turn to that sheet.

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



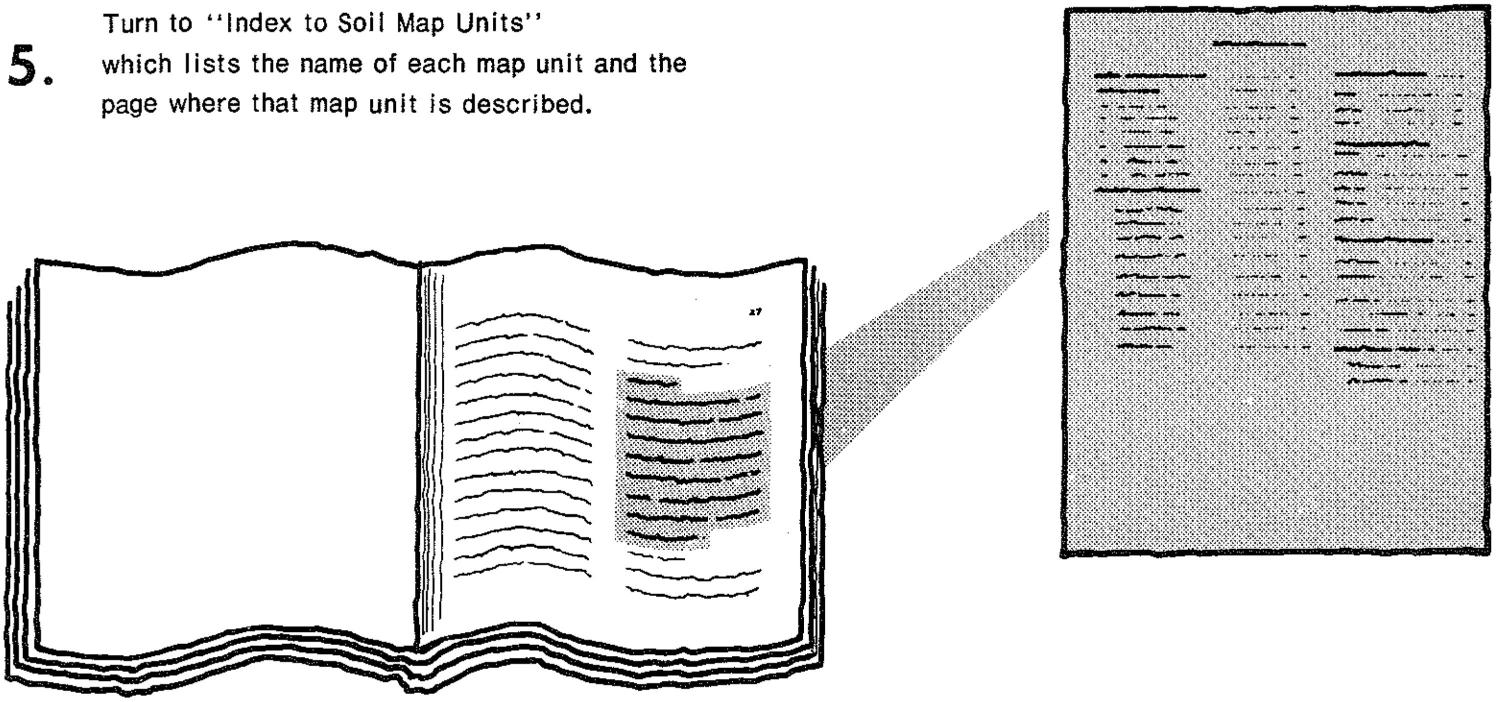


4. List the map unit symbols that are in your area.

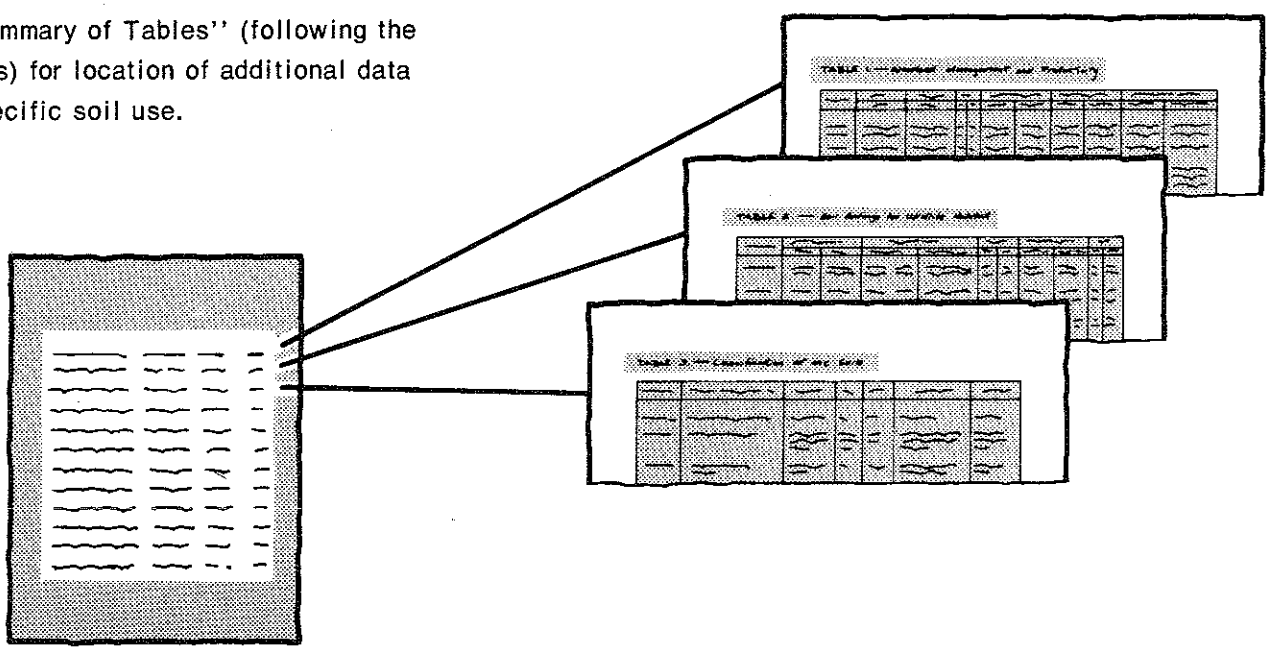


HIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was performed in the period 1971-1977. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the Ohio Department of Natural Resources, Division of Lands and Soil; and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Seneca Soil and Water Conservation District. The survey was materially aided by funds provided by the Seneca County Commissioners.

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

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Issued September 1980

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Summary of tables

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Foreword

We introduce the Soil Survey of Seneca County. You will find, herein, basic information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

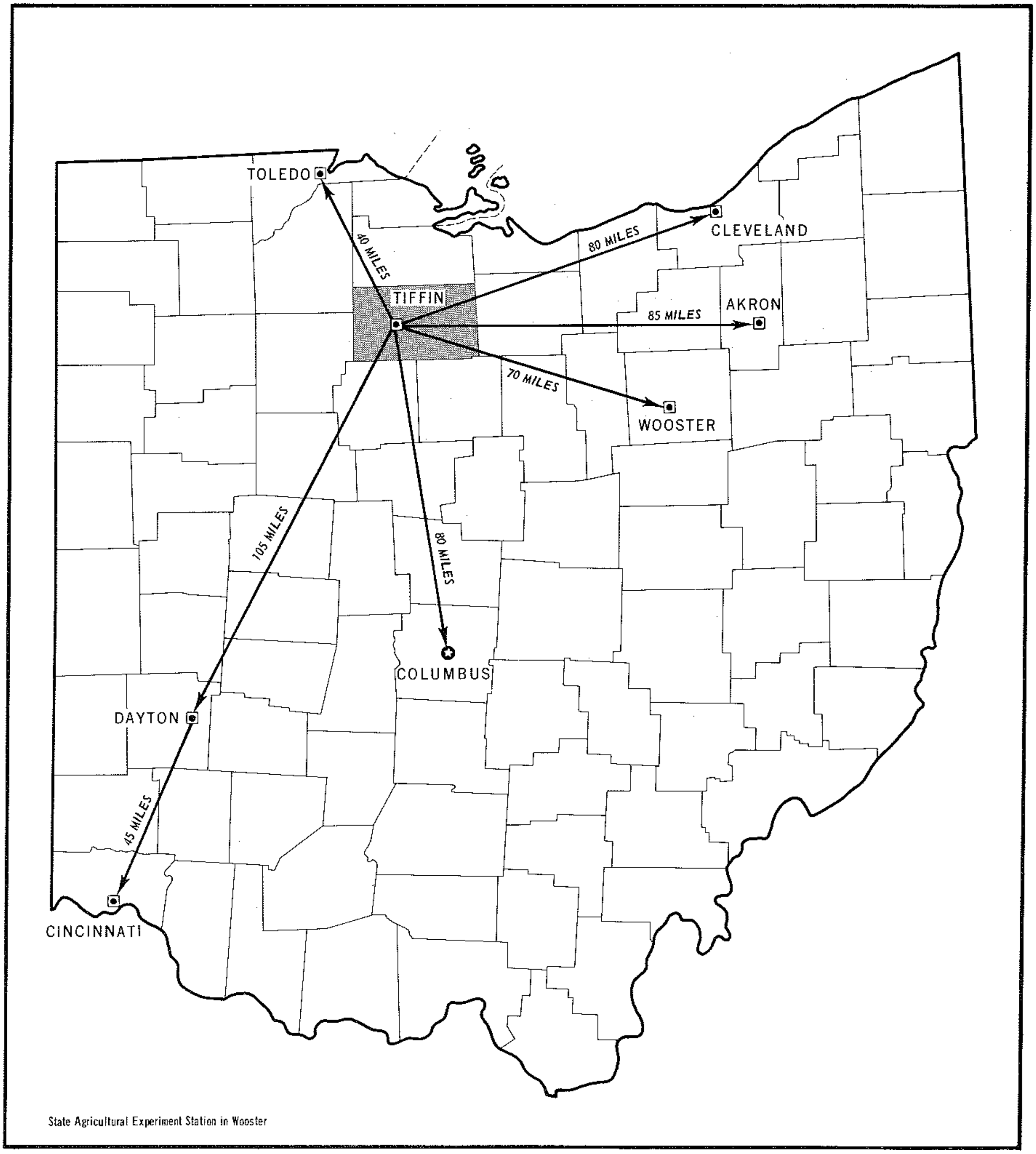
This soil survey has been prepared for many different users. Farmers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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. This publication also shows on the general soil map, the location of broad areas of soil, and on detailed soil maps, the location of each kind of soil. It provides descriptions of each kind of soil in the survey area and gives much information about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

We believe that this soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Robert E. Quilliam
State Conservationist
Soil Conservation Service



Location of Seneca County in Ohio.

SOIL SURVEY OF

SENECA COUNTY, OHIO

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

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Ohio Department of Natural Resources
Division of Lands and Soil

SENECA COUNTY is in north-central Ohio. It occupies about 551 square miles, or 352,640 acres. Tiffin, the county seat, is near the center of the county. In 1970, the total population of the county was 60,696.

Seneca County, named for the Seneca Indians, was formed from part of the congresslands of 1820 and 1821. The first settlement, in 1817, was on the banks of the Sandusky River at Fort Ball, now part of the city of Tiffin. The early settlers rapidly cleared the land for farming. Farming was practically their only means of support until oil was discovered in 1888.

Agriculture dominated by cash grain and livestock farming is the major land use. Corn, soybeans, wheat, oats, and hay are grown on many farms. Special crops, such as tomatoes, sugar beets, cabbage, and cucumbers, are grown in some areas. There are a few areas of woodland on steep and very steep slopes along the Sandusky River and in undrained areas or in areas where the soil is shallow over bedrock.

Fewer livestock and more cash grain farming is a continuing trend. Special crops, such as tomatoes, sugar beets, cabbage, and cucumbers, contribute significantly to the economy.

Because high-quality limestone is fairly near the surface, the county has a large limestone processing industry for agricultural and industrial use.

Although industry has increased greatly in Tiffin and Fostoria, farming continues to be the principal segment of the economy. Farming has continuously kept Seneca County in the upper 12 percent of the 88 counties in Ohio.

Poor natural drainage is the major limitation in the flatter areas. Erosion is a hazard in the gently sloping to steep areas. Under adequate artificial drainage, erosion control, and other appropriate management, most of the soils are highly productive.

Although Seneca County is dominantly agricultural, nonfarm development, mainly residential, is progressing. This development is not on the scale that prevails in the vicinity of large metropolitan areas, but many of the same soil-related limitations and hazards are common.

General nature of the survey area

On the pages that follow is general information on the climate of the county, the physiography, relief, and drainage, and the agriculture.

Climate

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

Seneca County is cold in winter and uncomfortably warm in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture in spring and on most soils minimizes the hazard of drought in summer. Normal annual precipitation is adequate for all crops that are suited to the temperature and the length of the growing season.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Tiffin, Ohio for the period 1951 to 1976. 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 29 degrees F, and the average daily minimum temperature is 21 degrees. The lowest temperature on record, for the period which occurred at Tiffin on January 24, 1963, is -18 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 August 31, 1951 is 100 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (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.

The total annual precipitation is 33 inches. Of this, 20 inches, or 60 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 18 inches. The heaviest 1-day rainfall during the period of record was 3.03 inches at Tiffin on September 2, 1961. Thunderstorms occur on about 40 days each year, and most occur in summer.

Average seasonal snowfall is 29 inches. The greatest snow depth at any one time during the period of record was 16 inches. On an average of 21 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 southwest. Average windspeed is highest, 11 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

Seneca County is in the Central Lowlands, which includes most of the glaciated part of Ohio. It straddles the Lake Plain and Till Plain areas of that region. The Late Wisconsion drift covered all the material left by former glaciers. A mantle of glacial drift, which ranges from a few feet to less than a hundred feet in thickness, overlies limestone bedrock throughout most of the county and shale bedrock at the extreme southeast edge of the county. In most areas, the underlying limestone is of the Niagara, Monroe, Columbus, and Delaware Formations. The underlying shale is the Ohio Shale Formation.

Relief of the county is mainly nearly level to undulating. Steeper areas are along streams. The major part of the county is a till plain where Blount, Pandora, and Tiro soils are dominant.

The till plain is divided in the southeastern part of the county by the Defiance end moraine (*5*), which enters from the south in Eden Township and extends through Bloom, Scipio, Venice, and Reed Townships. In this morainic area, the relief is more pronounced than on the till plain and erosion is more severe. The end moraine was deposited when the ice remained stationary during the retreat of the glacier. Glynwood and Blount are the major soils on the Defiance end moraine. Areas of sandy and gravelly outwash terraces occur along the base of the moraine and on stream terraces in the Sandusky River Valley. Gallman, Haney, and Digby soils are dominant in the terraced areas.

In the northwestern part, relief is more subdued than in the rest of the county. After the glacier receded to a point north of the area that is now Seneca County, a large glacial lake formed. It extends from the northwestern part of the county, north to Lake Erie. The soils in this lakebed are generally high in clay content. Relief is nearly level. Major soils in this area are Hoytville and Nappanee. Prominent beach ridges of sandy or gravelly material, formed by wave action, parallel State Routes 18, 101, and 12. Belmore, Spinks, Haskins, and Kibbie soils are dominant on the beach ridges. The nearly level plain is also interrupted by gently sloping limestone highs that were islands in the old glacial lake. Milton, Millsdale, and Channahon soils are dominant on these highs.

Most of the county is part of the Sandusky River basin. Most of the major streams that flow through Seneca County drain into this river. A small area in the extreme southwest corner of the county, however, drains into the Blanchard River and a small area at the eastern edge drains into the Huron River.

Agriculture

Seneca County is an important agricultural county in Ohio. According to the Ohio Crop Reporting Service (*13*) in 1977, approximately 93.6 percent of the area was farmed. There were 1,950 farms, averaging 170 acres (*13*). The county was fourth in the production of sugar beets, fifth in wheat, seventh in oats, ninth in soybeans, and twenty-first in corn.

In 1976 the major products in terms of the percentage of cash receipts were soybeans, 33 percent; corn, 20 percent; wheat, 10 percent; dairy products, 9 percent; hogs, 9 percent; vegetables, 6 percent; cattle, 4 percent; sugar beets, 2 percent; and all other, 7 percent (*4*).

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 for broad land use planning" and "Soil maps for detailed planning."

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 for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

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

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

Deep soils on till plains

These soils make up about 62 percent of the county. They are moderately well drained to poorly drained, nearly level to sloping soils formed in dominantly glacial till. The landscape ranges from broad flats on ground moraines to rolling areas on end moraines. The acreage is mainly farmed. Erosion, seasonal wetness, and moderately slow or slow permeability are the major limitations.

1. Blount-Pandora association

Nearly level and gently sloping, somewhat poorly drained and poorly drained soils formed in moderately fine textured glacial till

This association is on undulating ground moraines of swells and shallow depressions. It is dominantly nearly level and gently sloping but is sloping along some drainageways. It makes up about 45 percent of the county. It is about 70 percent Blount soils, 10 percent Pandora soils, and 20 percent soils of minor extent.

Blount soils are somewhat poorly drained, medium textured, and nearly level to gently sloping. They are on broad flats, slight rises, and low knolls. Permeability is slow or moderately slow. The seasonal high water table is at a depth of 12 to 36 inches. Pandora soils are poorly drained, medium textured, and nearly level. They are in shallow depressions and drainageways. Permeability is slow. The seasonal high water table is near the surface. Both soils have moderate organic matter content and available water capacity.

Minor in this association are Glynwood soils on crests of knolls and in some higher areas and Pewamo soils in depressions and along drainageways. Haskins soils are on slight rises and low knolls. Shoals and Chagrin soils are on flood plains.

This association is used mainly as cropland. A few undrained areas are in pasture and woodland. The main enterprises are cash grain and general farming. Corn, soybeans, small grain, and hay are the dominant crops. The potential is high for farming and woodland. It is low for building site development and sanitary facilities. It is medium or low for most recreation uses.

The seasonal high water table is the main limitation for most uses. Wetness delays planting and limits the choice of crops. Surface and subsurface drains are needed. Maintaining tilth on both of the major soils and controlling erosion on the gently sloping Blount soils are important if the soils are farmed. The moderately slow or slow permeability severely limits the use of these soils for sanitary facilities, such as septic tank effluent fields.

Low strength limits their use for local roads and streets. Blount soils are better suited as building sites than Pandora soils. Sites should be graded to provide good surface drainage away from the foundation.

2. Tiro-Pandora association

Nearly level and gently sloping, somewhat poorly drained and poorly drained soils formed in moderately fine textured lacustrine and alluvial sediments and glacial till

This association is on undulating till plains of swells and shallow depressions. The soils are mainly nearly level and gently sloping, and areas of sloping soils are along some drainageways. The association makes up about 10 percent of the county. It is about 75 percent Tiro soils, 10 percent Pandora soils, and 15 percent soils of minor extent.

Tiro soils are somewhat poorly drained, nearly level and gently sloping, and medium textured. They are on broad flats, slight rises, and low knolls. Permeability is moderate in the upper part of the subsoil and moderately slow in the lower part and in the substratum. The seasonal high water table is at a depth of 12 to 30 inches. Pandora soils are poorly drained, medium textured, and nearly level. They are in shallow depressions and drainageways. Permeability is slow. The seasonal high water table is near the surface. The content of organic matter is moderate and the available water capacity is moderate in both soils.

Minor in this association are Bennington soils on convex knolls; Lenawee, Colwood, and Pewamo soils in swales and low concave areas; and Shoals soils on narrow flood plains.

This association is used mainly for cultivated crops. A few undrained areas are in pasture or woodland. The main enterprises are cash grain and general farming. The potential is high for cultivated crops and woodland. It is low for building site development and sanitary facilities as a result of wetness, moderately slow or slow permeability, ponding, and low strength.

Corn, soybeans, small grain, and hay are the main crops. The main concerns of management are improving drainage, controlling erosion, and maintaining tilth and fertility. Drainage ditches and subsurface drains are needed. The moderately slow and slow permeability severely limits the use of these soils for sanitary facilities, such as septic tank effluent fields. Tiro soils are better suited as sites for buildings than Pandora soils. Building sites should be graded to provide good surface drainage away from the foundation.

3. Glynwood-Pandora-Blount association

Nearly level to sloping, moderately well drained to poorly drained soils formed in moderately fine textured glacial till

This association is on rolling end moraines with hill crests, broad swells, and drainageways. It is dominantly nearly level to sloping but is steep along some drainageways. It makes up about 5 percent of the county. It is about 40 percent Glynwood soils, 30 percent Pandora soils, 25 percent Blount soils, and 5 percent soils of minor extent.

Glynwood soils are moderately well drained, medium textured and moderately fine textured, and nearly level to sloping. They are on hillsides and convex ridgetops. Permeability is slow. The seasonal high water table is at a depth of 24 to 42 inches. The available water capacity is moderate. The organic matter content is moderate or moderately low.

Pandora soils are poorly drained, medium textured, and nearly level. They are in shallow depressions and drainageways. Permeability is slow. The seasonal high water table is near the surface. The content of organic matter is moderate. The available water capacity is moderate.

Blount soils are somewhat poorly drained, medium textured, nearly level, and gently sloping. They are on slight rises and low knolls. Permeability is slow or moderately slow. The seasonal high water table is at a depth of 12 to 36 inches. The content of organic matter is moderate. The available water capacity is moderate.

Minor in this association are Morley and Belmore soils on knolls, ridges, and side slopes. Pewamo soils are in depressions.

This association is used mainly for row crops, small grain, and hay. A few steep areas and some undrained areas are in permanent pasture and woodland. General farming is the main enterprise. The potential is high for row crops and woodland. It is low or medium for building site development and sanitary facilities as a result of seasonal wetness, slow or moderately slow permeability, shrink-swell potential, slope, ponding, and low strength.

Wetness and the erosion hazard are the main limitations for farming. Erosion is especially a hazard on the sloping Glynwood soils. Corn, soybeans, small grain, and hay are the principal crops. The gently sloping Glynwood soils are better suited as building sites than Pandora and Blount soils. All are poorly suited to sanitary facilities, such as septic tank effluent fields, as a result of slow or moderately slow permeability.

4. Glynwood-Blount association

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

This association is in broad areas that have slight undulations and sink holes. The nearly level and gently sloping soils are mainly on uneven slopes. The association makes up about 2 percent of the county. It is about 60 percent Glynwood soils, 20 percent Blount soils, and 20 percent soils of minor extent.

Glynwood soils are moderately well drained, medium textured and moderately fine textured, and nearly level to gently sloping. They are on slight rises and low knolls.

Permeability is slow. Organic matter content is moderate or moderately low. The available water capacity is moderate. The seasonal high water table is at a depth of 24 to 42 inches.

Blount soils are somewhat poorly drained, medium textured, and nearly level to gently sloping. They are on broad flats and slight rises. Permeability is moderately slow or slow. Organic matter content is moderate. The available water capacity is moderate. The seasonal high water table is at a depth of 12 to 36 inches.

Minor in this association are Pandora soils in shallow depressions and drainageways; Haskins soils on slight rises and low knolls; Spinks, Seward, and Morley soils on knolls and ridges; and Shoals soils on narrow flood plains.

This association is used mainly for row crops. A few areas are in woodland. The main enterprise is general farming. The potential is high for row crops, hay, pasture, and woodland. It is low or medium for building site development and sanitary facilities.

Seasonal wetness, erosion hazard, and slow or moderately slow permeability are the main limitations. Corn, soybeans, small grain, and hay are the principal crops. Glynwood soils are better suited to building site development than Blount soils. Both are poorly suited to sanitary facilities, such as septic tank effluent fields, because of the slow or moderately slow permeability.

Deep soils on beach ridges, terraces, lake plains, outwash plains, and end moraines

These soils make up about 30 percent of the county. They are well drained to very poorly drained and nearly level to sloping. They formed in glaciofluvial deposits and glacial till. They are used mainly for row crops. Seasonal wetness and slow or very slow permeability are major limitations.

5. Kibbie-Digby association

Nearly level and gently sloping, somewhat poorly drained soils formed in medium to coarse textured sediments

This association is on broad flats on beach ridges, stream terraces, and lake plains. It makes up about 10 percent of the county. It is about 30 percent Kibbie soils, 15 percent Digby soils, and 55 percent soils of minor extent.

Kibbie soils are somewhat poorly drained, moderately coarse textured, and nearly level. They are on broad flats and slight rises. They formed in glaciofluvial deposits on lake plains. Permeability is moderate, and the available water capacity is high. Organic matter content is moderate. The seasonal high water table is at a depth of 12 to 24 inches.

Digby soils are somewhat poorly drained, medium textured, and nearly level to gently sloping. They are on broad flats and slight rises. They formed in glacial outwash on beach ridges and stream terraces. Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderate. The seasonal high water table is at a depth of 12 to 30 inches.

Minor in this association are Lenawee, Colwood, Mermill, and Millgrove soils in low lying areas; Spinks and Gallman soils on knolls and ridges; Rimer soils on slight rises; Nappanee and Fitchville soils on broad flats on lake plains; and Chagrin soils in narrow strips on flood plains.

This association is used mainly for farming. Cash-grain farming is the main enterprise. The potential is high for row crops, hay, pasture, and woodland. It is low for building site development and sanitary facilities.

Seasonal wetness is the main limitation. Artificial drains are effective in most areas. The soils are suited to corn, soybeans, small grain, and hay. They are fairly easy to till. Sanitary facilities, such as sewage lagoons, are limited by the possible pollution of underground water supplies. Building sites should be graded to provide good surface drainage away from the foundation.

6. Hoytville-Nappanee association

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

This association is on broad, flat, uniform lake basins that have slight rises. Differences in elevation range from 0 to 10 feet. The soils are mainly nearly level, and the gently sloping soils are on rises. The association makes up about 15 percent of the county. It is about 70 percent Hoytville soils, 20 percent Nappanee soils, and 10 percent soils of minor extent.

Hoytville soils are very poorly drained, moderately fine textured, and nearly level. They are on smooth flats. Permeability is slow. Organic matter content is high. The available water capacity is moderate. The seasonal high water table is near the surface.

Nappanee soils are somewhat poorly drained, medium textured, and nearly level to gently sloping. They are on very slight rises. Permeability is very slow. The seasonal high water table is at a depth of 12 to 24 inches. Organic matter content is moderate. The available water capacity is moderate.

Minor in this association are Colwood soils formed in coarser textured material and Millsdale soils that have limestone bedrock at a depth of 20 to 40 inches. The Millsdale and Colwood soils are in depressions. Belmore, Digby, Haney, and Millgrove soils are on or near beach ridges. Narrow strips of Chagrin and Shoals soils are on flood plains.

This association is used mainly for row crops. A few undrained areas are used for woodland. Cash grain farming is the main enterprise. The potential is high or medium for row crops and pasture. It is low for building site development and sanitary facilities and medium or low for recreation uses.

Seasonal wetness and slow or very slow permeability of both soils and the ponding on the Hoytville soils are the main limitations. Surface and subsurface drains are commonly needed to remove excess surface water and lower the water table, but water moves slowly into subsurface drains. Drained areas are suited to corn and soybeans. Leaving crop residue on the surface in fall and not plowing until spring help to protect the soils against erosion. Foundations should be designed to prevent structural damage caused by shrinking and swelling.

7. Gallman-Digby-Haney association

Nearly level to sloping, well drained to somewhat poorly drained soils formed in moderately fine textured to moderately coarse textured sediments

This association is on stream terraces, narrow convex ridges that mark the shorelines of post-glacial lakes, and broad terraces that have rises and knolls, outwash plains, and end moraines. It makes up about 5 percent of the county. It is about 20 percent Gallman soils, 20 percent Digby soils, 15 percent Haney soils, and 45 percent soils of minor extent.

Gallman soils are well drained, medium textured, and nearly level and gently sloping. They are on slightly elevated broad flats, gentle rises, and knolls on stream terraces, outwash plains, and end moraines. Permeability is moderately rapid, and the available water capacity is moderate. Organic matter content is moderate.

Digby soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats and slight rises on stream terraces and beach ridges. Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderate. The seasonal high water table is at a depth of 12 to 30 inches.

Haney soils are moderately well drained, medium textured, and nearly level to sloping. They are on slight rises of beach ridges, outwash plains, and stream terraces. Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderate or moderately low. The seasonal high water table is at a depth of 24 to 42 inches.

Minor in this association are Haskins and Rawson soils on slight rises; Milton Variant, Spinks, Belmore, and Oshtemo soils on slight rises and knolls; and Chagrin and Shoals soils on flood plains.

This association is used mainly for cultivated crops consisting of corn, soybeans, and small grain. Some areas are used for hay, pasture, and woodland. Cash-grain farming is the main enterprise. The nearly level and gently sloping soils have a high potential for farming. Gallman soils have a high potential for building site development, Haney soils a medium potential, and Digby soils a low potential.

The wetness of the Digby soils and the droughtiness and erosion hazard of the Gallman and Haney soils are concerns of management. Gallman soils are well suited to early maturing crops and to grazing early in spring. Subsurface drains are commonly needed in the Digby soils. Sanitary facilities, such as sewage lagoons, are limited on these soils by the possible pollution of underground water supplies.

Moderately deep and shallow soils on lake plains and till plains

These soils make up about 5 percent of the county. They are moderately deep and shallow and well drained and somewhat poorly drained. They formed in glacial till and residuum of limestone bedrock. These nearly level and gently sloping soils occur as a series of gentle rises and knolls in elevated areas of lake plains and till plains. They are used mainly for row crops. The limited depth to bedrock and the droughtiness and wetness are major limitations.

8. Milton-Randolph-Channahon association

Moderately deep and shallow, nearly level and gently sloping, well drained and somewhat poorly drained soils formed in moderately fine textured glacial till and residuum of limestone

This association is in elevated areas of lake plains and till plains. The landscape is one of gentle rises and knolls. Differences in elevation range from about 10 to 30 feet. The association makes up about 5 percent of the county. It is about 25 percent Milton soils, 15 percent Randolph soils, 15 percent Channahon soils, and 45 percent soils of minor extent.

Milton soils are moderately deep, well drained, medium textured, and nearly level and gently sloping. They are on crests and knolls. Permeability is moderate or moderately slow, and the available water capacity is low. Organic matter content is moderate.

Randolph soils are moderately deep, somewhat poorly drained, medium textured, and nearly level. They are on broad flats. Permeability is moderately slow, and the available water capacity is low. Organic matter content is moderate. The seasonal high water table is at a depth of 12 to 24 inches.

Channahon soils are shallow, well drained, medium textured, and nearly level to gently sloping. They are on slight rises and low knolls. Permeability is moderate, and the available water capacity is very low. Organic matter content is high.

Minor in this association are Colwood and Millsdale soils in low lying areas and Tiro soils on flats and low knolls. Colwood and Tiro soils are deep over bedrock.

Most of this association is used for row crops. A few areas are used for permanent pasture and woodland. General farming is the main enterprise. Milton soils have a high potential for row crops, Randolph soils a medium potential, and Channahon soils a low potential. The potential for building site development is higher in Milton soils than in Channahon or Randolph soils. The potential for sanitary facilities is low.

Corn, soybeans, small grain, and hay are commonly grown. The main concerns of management are the limited depth to bedrock, the droughtiness of all soils, and the seasonal wetness of the Randolph soils. Randolph soils dry out more slowly in spring than Channahon and Milton soils. All are poorly suited to sanitary facilities, such as septic tank absorption fields, because of the limited depth to bedrock. All are better suited to houses without basements than to houses with basements because of the wetness of the Randolph soils and the need for blasting bedrock in most areas before a basement can be constructed.

Deep soils on flood plains and terraces and in upland depressions

These soils make up about 3 percent of the county. They are well drained to very poorly drained soils on flood plains, on low stream terraces, and in concave depressions of uplands and terraces. They are used for cultivated crops and as habitat for wetland wildlife. Wetness and flooding are major limitations.

9. Chagrin-Shoals-Ross association

Nearly level, well drained and somewhat poorly drained soils formed in medium textured and moderately fine textured alluvium

This association is on broad flats of flood plains and low stream terraces. Differences in elevation range from 0 to 10 feet. The nearly level soils are subject to flooding. The association makes up about 2 percent of the county. It is about 55 percent Chagrin soils, 20 percent Shoals soils, 15 percent Ross soils, and 10 percent soils of minor extent.

Chagrin soils are well drained, occasionally flooded, and medium textured. They are on flood plains. Permeability is moderate. Organic matter content is moderate. The available water capacity is high.

Shoals soils are somewhat poorly drained, frequently flooded, and medium textured. They are in shallow depressions and meander channels of flood plains. Permeability is moderate. Organic matter content is moderate. The available water capacity is high. The seasonal high water table is at a depth of 12 to 36 inches.

Ross soils are well drained, occasionally flooded, medium textured, and nearly level. They are on flood plains and low stream terraces. Permeability is moderate. Organic matter content is high. The available water capacity is high.

Minor in this association are Fitchville and Digby soils on terraces and Lenawee and Colwood soils on flats and in depressions.

This association is used mainly for cultivated crops. Some undrained areas are used for woodland. Cash-grain farming is the main enterprise. The potential is high for cultivated crops and low for building site development and sanitary facilities. Chagrin and Ross soils have a medium or high potential for recreation uses, and Shoals soils have a low potential for this use.

The flood hazard of all the soils and the seasonal wetness of the Shoals soils are the main limitations. The soils are suited year after year to row crops, such as corn and soybeans, that can be planted after the major threat of flooding. In most years row crops can be planted and harvested during the nonflood period. Winter grain crops are limited by the flood hazard. Diking to control flooding is difficult.

10. Carlisle-Linwood association

Nearly level, very poorly drained soils formed in deep organic deposits or in organic deposits over medium textured and moderately coarse textured mineral material

This association is in concave depressions on uplands and terraces. The soils are subject to frequent flooding. Undrained areas are swampy and support only water-tolerant reeds, sedges, and rushes. The association makes up less than 1 percent of the county. It is about 20 percent Carlisle soils, 20 percent Linwood soils, and 60 percent soils of minor extent.

Carlisle soils are very poorly drained and nearly level. They are in depressions. Permeability is moderately slow to moderately rapid. Linwood soils are very poorly drained and nearly level. They are in depressions. Permeability is moderate. In both soils organic matter content is very high and the available water capacity is very high. The seasonal high water table is near the surface in both soils.

Minor in this association are Colwood, Millgrove, and Lenawee soils on flats and very slight rises on the periphery of areas and Shoals soils on flood plains.

Drained areas of this association are used for cultivated crops, and undrained areas as habitat for wetland wildlife. The potential is good as habitat for wetland wildlife. It is poor for building site development, sanitary facilities, and recreation. Drained areas have potential for row crops and some specialty crops.

Flooding, low strength, wetness, and seepage are limitations. Surface and subsurface drains are effective, but suitable outlets for subsurface drains are difficult to establish in many areas. Subsidence or shrinkage occurs as the result of the oxidation of the organic material after the soils are drained. Undrained areas provide good habitat for ducks, muskrats, and other wetland wildlife.

Soil maps for detailed planning

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, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Haney loam, 0 to 2 percent slopes is one of several phases in the Haney series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Belmore-Morley complex, 18 to 50 percent slopes, eroded is an example.

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

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

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

Soil descriptions

BdB—Belmore loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is in undulating areas on stream terraces and beach ridges. Most areas are long and narrow and range from 3 to 60 acres.

Typically, the surface layer is dark brown, friable loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is dark brown, friable clay loam, the middle part is dark brown, friable and firm gravelly clay loam and sandy loam, and the lower part is yellowish brown, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is light brownish gray, very friable and loose gravelly sandy loam with thin strata of gravelly sand.

Included with this soil in mapping are small areas of somewhat poorly drained Digby soils in lower lying positions. Also included are areas of moderately well drained and well drained Rawson soils that formed in glacial outwash over glacial till in similar landscape positions. Included soils make up about 10 percent of most areas.

Permeability is moderately rapid. Runoff is medium. The root zone is mainly deep, and the available water capacity is moderate. Organic matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The subsoil is neutral or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

Most of the acreage is farmed. Some areas are used for truck crops and sugar beets. The potential is high for cultivated crops, small grain, hay, pasture, and trees. It is high for building site development, sanitary facilities, and recreation uses. It is low for water impoundments.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. The surface layer reaches the optimum moisture content for tillage much sooner after rains than soils with a higher clay content. The soil dries early in spring. Because of the limited available water capacity, it is better suited to crops that mature early than to crops that mature late in summer. Droughtiness and controlling erosion are the main management concerns. This soil is well suited to irrigation. Minimum tillage, cover crops, and grassed waterways help to reduce runoff and soil loss. Incorporating crop residue or other organic matter into the surface layer helps to increase the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact. Because plant nutrients are leached at a moderately rapid rate, smaller, more frequent or timely applications of fertilizer and lime are more suitable than one large application.

This soil is well suited to deep rooted grasses and legumes for hay and pasture and to grazing early in spring. Pastures and meadows of shallow rooted legumes and grasses tend to dry out when rainfall is below normal.

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

This soil is well suited as a site for building development, septic tank absorption fields, and recreation uses. Replacing the subsoil with suitable base material can improve local roads. Maintaining a plant cover, wherever possible, reduces runoff and the risks of erosion during construction. Seepage from sewage lagoons or trench type sanitary landfills can pollute the underground water supply. This soil is suitable for lawns.

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

BfF2—Belmore-Morley complex, 18 to 50 percent slopes, eroded. This map unit consists of steep and very steep, deep, well drained Belmore and Morley soils on side slopes that parallel drainageways. Most areas range from 20 to 100 acres. They are 50 to 65 percent Belmore loam and 20 to 30 percent Morley silt loam. The Belmore soil is on upper slopes near ridgetops. The Morley soil is on narrow steep slope breaks and on lower slopes. Areas of both soils are so intricately mixed or so small that mapping them separately is not practical.

Typically, the Belmore soil has a surface layer of dark brown, friable loam about 2 inches thick. The subsoil is dark brown, friable gravelly clay loam about 30 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous, very friable gravelly sand.

Typically, the Morley soil has a surface layer of brown silt loam about 2 inches thick. The subsoil is brown and dark yellowish brown, firm silty clay loam and clay loam about 20 inches thick. The substratum to a depth of about 60 inches is mottled dark yellowish brown and brown, calcareous, firm clay loam and silty clay loam.

Included with this unit in mapping are small areas of soils that have a silt loam subsoil and substratum. These soils are subject to slippage. They make up 5 to 10 percent of most areas.

Permeability is moderately rapid in the Belmore soil and moderately slow or slow in the Morley soil. Runoff is very rapid. The available water capacity is moderate. Organic matter content is moderately low. The subsoil of the Belmore soil is neutral or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The subsoil of the Morley soil is medium acid to neutral. The root zone is mainly moderately deep in both soils.

Most of the acreage is wooded or pastured. The potential is low for cultivated crops, building site development, and sanitary facilities. It is high for woodland and habitat for woodland wildlife.

The steep and very steep slope and the erosion hazard limit these soils for cultivated crops and hay. In some areas soils of 18 to 25 percent slopes are suited to adapted grasses and legumes for hay and pasture. No-till seeding and maintaining a plant cover reduce runoff and the risk of erosion. The Belmore soil dries earlier in spring than the Morley soil. Plant nutrients are leached more rapidly from the Belmore soil than from the Morley soil. As a result, smaller, more frequent applications of lime and fertilizer are needed on the Belmore soil. Proper stocking, pasture rotation, and timely deferment of grazing are good management practices.

The soils in this unit are suited to woodland. Logging and planting equipment is restricted because of slope. Seedlings are difficult to establish during extended dry periods, especially on the Belmore soil. Logging roads and skid trails should be protected against erosion and constructed on the contour if possible.

The steep and very steep slope severely limits these soils as sites for building development and sanitary facilities. Maintaining a plant cover as much as possible during construction reduces the erosion hazard. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

The capability subclass is VIIe. The woodland suitability subclass is 2r.

BgB—Bennington silt loam, 2 to 6 percent slopes. This gently sloping, deep, somewhat poorly drained soil is in bands along small waterways. Areas range from 2 to 60 acres. Some are irregular in shape.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown, mottled, friable and firm silty clay loam, and the lower part is dark yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm clay loam.

Included with this soil in mapping and making up about 5 percent of most areas are small areas of Haskins soils on low knolls and well drained Milton soils in which bedrock is at a depth of 20 to 40 inches. Haskins soils have less clay in the subsoil.

Permeability is slow, and the available water capacity is moderate. Organic matter content is moderate. The shrink-swell potential is moderate in the subsoil. The potential frost action is high. Runoff is medium. The soil has good tilth. The seasonal high water table is perched at a depth of 12 to 30 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The subsoil is medium acid or strongly acid in the upper part and slightly acid or neutral in the lower part.

Most areas are farmed. Drained areas have high potential for cultivated crops, hay, and pasture. The potential is low for most kinds of building site development and sanitary facilities. It is medium for many kinds of recreation uses.

This soil is suited to row crops and small grain. Wetness and erosion control are the main limitations in farming. Both surface and subsurface drains are needed. Minimizing tillage and incorporating crop residue or other organic matter into the surface layer improve tilth and fertility, increase the rate of water infiltration, reduce crusting, and improve the soil-seed contact. Leaving crop residue on the surface in fall and not plowing until spring also help to protect the soil against erosion.

This soil is well suited to pasture or hay, but it is poorly suited to grazing early in spring. The surface layer compacts easily, resulting in poor tilth and damage to pasture plants if grazed when wet. Proper stocking, plant selection, pasture rotation, and timely deferment of grazing help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities, and it is moderately limited for most kinds of recreation uses because of slow permeability, seasonal wetness, and low strength. Artificial drains are needed. Protective exterior wall coatings also help to prevent wet basements. The increased runoff and erosion that occur during construction can be reduced by maintaining a plant cover wherever possible. Sites should be graded to provide good surface drainage away from the foundation. Local roads can be improved by artificial drainage and using suitable base material.

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

BgB2—Bennington silt loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, somewhat poorly drained soil is along well defined waterways in the uplands. Erosion has removed part of the original surface layer. Most areas are 4 to 50 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is yellowish brown and dark yellowish brown, mottled, firm silty clay loam about 25 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm clay loam. In some areas, the surface layer is yellowish brown silty clay loam where the upper part of the subsoil has been mixed with the surface layer. In some areas, slope is 6 to 9 percent.

Included with this soil in mapping are somewhat poorly drained Haskins soils on low knolls and well drained Milton soils in which bedrock is at a depth of 20 to 40 inches. Included soils make up about 10 percent of most areas.

Permeability is slow. The available water capacity is moderate, although it has been reduced by erosion. Organic matter content is moderately low. The shrink-swell potential is moderate in the subsoil. The potential frost action is high. Runoff from cultivated areas is medium. The seasonal high water table is perched at a depth of 12 to 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till. The subsoil is medium acid or strongly acid in the upper part and slightly acid or neutral in the lower part.

Most areas are farmed. Drained areas have high potential for cultivated crops, hay, and pasture. The potential is low for most building site development and sanitary facilities. It is medium for many kinds of recreation uses.

This soil is suited to row crops and small grain. Erosion control and wetness are the main limitations in farming. The surface layer crusts after hard rains. Minimizing tillage and incorporating crop residue or other organic matter into the surface layer help to improve tilth and fertility, increase the rate of water infiltration, reduce crusting, and improve the soil-seed contact. Leaving crop residue on the surface in fall and not plowing until spring also help to protect the soil against erosion. Both surface and subsurface drains are needed.

Using this soil for pasture or hay effectively controls erosion. Overgrazing or grazing when the soil is soft and sticky as a result of wetness, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

The slow permeability, seasonal wetness, and low strength are severe limitations for building sites and sanitary facilities, and they are moderate limitations for most kinds of recreation uses. These limitations can be partly or fully overcome by specially designed facilities. Artificial drains are effective. Building sites should be graded to provide good surface drainage away from the foundations. Foundation drains and protective exterior wall coatings help to prevent wet basements. The increased runoff and erosion that occur during construction can be reduced by maintaining a plant cover wherever possible. Local roads can be improved by artificial drainage and using a suitable base material.

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

BoA—Blount silt loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is in broad areas of the uplands. Most areas are irregular in shape and 5 to 200 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 23 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam and silty clay, and the lower part is brown and dark brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is dark brown, firm silty clay loam.

Included with this soil in mapping are small areas of moderately well drained Glynwood soils and somewhat poorly drained Haskins soils on low knolls and poorly drained Pandora soils and very poorly drained Pewamo soils in depressions and along drainageways. Included soils make up about 15 percent of most areas.

Permeability is slow or moderately slow. The available water capacity is moderate. Organic matter content is moderate. Runoff is slow. Reaction ranges from medium acid to strongly acid in the upper part of the subsoil to neutral or mildly alkaline in the lower part. This soil crusts easily after heavy rains. The seasonal high water table is perched at a depth of 12 to 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till.

Most areas are farmed. Drained areas have a high potential for row crops, hay, and pasture. The potential is low for most kinds of building site development and sanitary facilities. It is medium for most kinds of recreation uses.

This soil is suited to corn, soybeans, wheat, and oats. Seasonal wetness is the main limitation in farming. It delays planting and limits the choice of crops. Surface drains and land smoothing are commonly needed. Subsurface drains are used to lower the seasonal high water table. Minimizing tillage and incorporating crop residue or other organic matter into the surface layer improve tilth and fertility, reduce crusting, and increase infiltration.

The soil is suited to pasture and hay. Surface compaction, poor tilth, decreased infiltration, and reduced plant growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas support native hardwoods. Seedlings and cuttings of adapted species survive and grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

The slow or moderately slow permeability, low strength, and seasonal high water table are severe limitations for building site development and sanitary facilities and are moderate limitations for most kinds of recreation uses. These limitations can be partly or fully overcome by specially designed facilities. Ditches and subsurface drains are needed. Building sites should be graded to provide good surface drainage away from the foundation. Local roads can be improved by using artificial drainage and suitable base material. Foundation drains and protective exterior wall coatings help to prevent wet basements.

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

BoB—Blount silt loam, 2 to 6 percent slopes. This gently sloping, deep, somewhat poorly drained soil is in irregularly shaped, broad areas of the uplands. Most areas are 5 to 50 acres. Some are more than 100 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 24 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam and silty clay, and the lower part is brown and dark brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is dark brown, firm silty clay loam.

Included with this soil in mapping are small areas of moderately well drained Glynwood soils and somewhat poorly drained Haskins soils on knolls and ridges and poorly drained Pandora soils and very poorly drained Pewamo soils in depressions and narrow strips along waterways. Included soils make up as much as 15 percent of most areas.

Permeability is moderately slow or slow. The available water capacity is moderate. Organic matter content is moderate. Runoff is medium. Reaction ranges from medium acid or strongly acid in the upper part of the subsoil to neutral or mildly alkaline in the lower part. This soil crusts easily after heavy rains. The seasonal high water table is perched at a depth of 12 to 36 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep to compact glacial till.

Most areas of this soil are farmed. Drained areas have high potential for row crops, hay, and pasture. The potential is low for most building site development and sanitary facilities. It is medium for many kinds of recreation uses.

This soil is suited to corn, soybeans, wheat, and oats. Erosion control, wetness, and surface crusting are the main management concerns (fig. 1). Surface and subsurface drains are commonly needed. Grassed waterways should be used where water concentrates (fig. 2). Minimum tillage and deep rooted cover crops help to improve natural drainage. Incorporating crop residue or other organic matter into the surface layer helps to improve tilth and fertility, reduce crusting, and increase infiltration. Leaving crop residue on the surface in fall and not plowing until spring also protect the soil against erosion (fig. 3).

This soil is suited to pasture or hay. Surface compaction, reduced growth, poor tilth, and decreased infiltration rates result from overgrazing or grazing when this soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas support native hardwoods. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

The slow or moderately slow permeability, low strength, and wetness are severe limitations for building site development and sanitary facilities. These limitations can be partly or fully overcome by specially designed facilities. Because increased runoff and erosion occur during construction, a plant cover should be maintained on the site as much as possible. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective exterior wall coatings help to keep basements dry. Ditches and subsurface drains are needed. Local roads can be im-

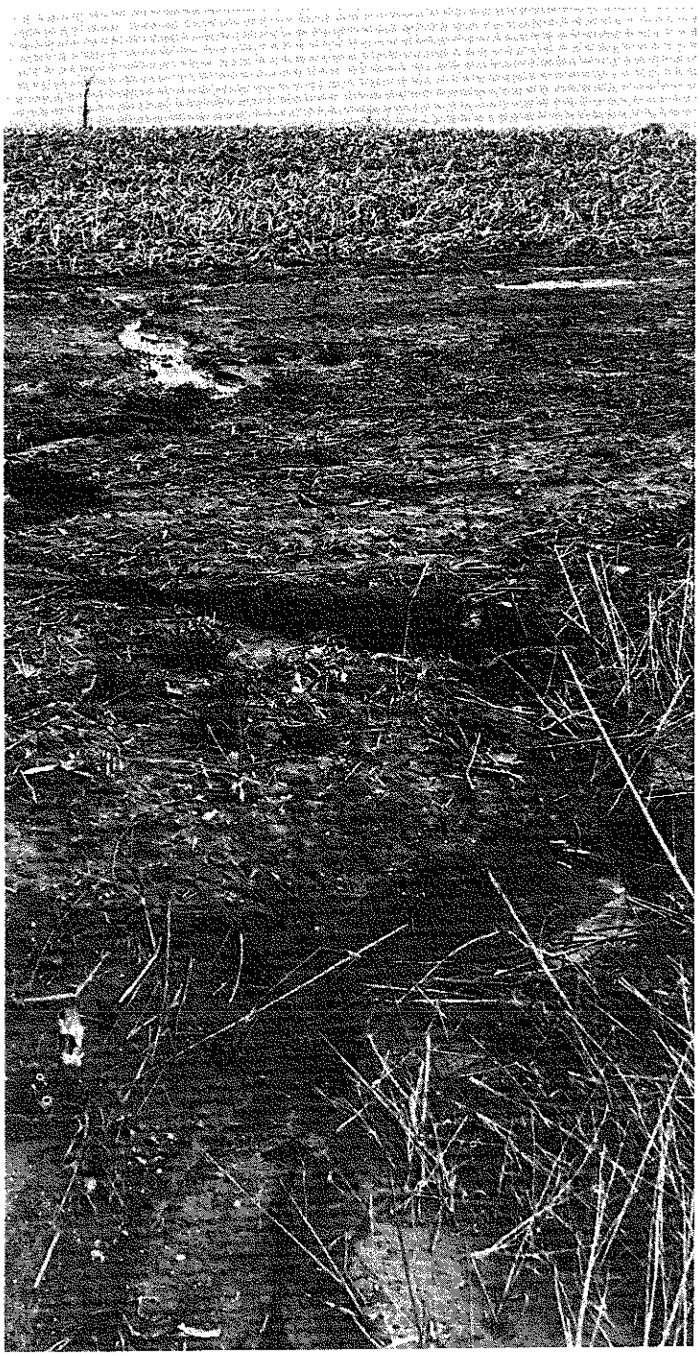

Figure 1.—Gully in unprotected area of Blount silt loam, 2 to 6 percent slopes.

proved by artificial drainage and using suitable base material.

The capability subclass is IIe. The woodland suitability subclass is 3o.

Bp—Bono silty clay, loamy substratum. This deep, nearly level, very poorly drained soil is in flat or depressional areas of till plains. It is subject to ponding in the lower parts of depressions from runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are irregular in shape and range from 3 to 20 acres.

Typically, the surface layer is very dark gray, firm silty clay about 12 inches thick. The subsoil is gray, mottled, firm silty clay about 26 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay loam in the upper part and gray, mottled, friable silt loam with thin strata of fine sand in the lower part.

Included with this soil in mapping are small areas of poorly drained Pandora soils and very poorly drained Lenawee soils that have less clay in the surface layer and better tilth.

The seasonal high water table is perched near the surface in winter, spring, and other extended wet periods. Permeability is slow or very slow. Runoff is very slow or ponded. The root zone is moderately deep or deep. The available water capacity is moderate. This soil can be tilled only within a narrow range of moisture. Organic matter content is high. The subsoil is neutral or mildly alkaline.

This soil is used for farming, woodland, and pasture. The potential is high for row crops, hay, pasture, trees, and habitat for wetland wildlife. It is low for most kinds of building site development, sanitary facilities, and recreation uses.

The wetness, clayey surface layer, and slow or very slow permeability are the main limitations in farming. Undrained areas are too wet for cultivated crops. Drained areas are well suited to corn and soybeans. Surface and subsurface drains are commonly needed. Tillage within a limited range of moisture content is important because this soil becomes compacted and cloddy if worked when wet and sticky. Minimizing tillage, planting cover crops, and incorporating crop residue or other organic matter into the surface layer help to maintain tilth, increase the rate of water infiltration, improve fertility, reduce crusting, and improve soil-seed contact.

Drained areas of this soil are suited to pasture or hay, but they are poorly suited to grazing early in spring. Surface compaction, poor tilth, decreased infiltration, and reduced plant growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Planting grasses and legumes that are tolerant of wetness, rotating pasture, and timely deferring of grazing improve pasture.

The soil is suited to water-tolerant trees and shrubs. A few small areas support native hardwoods. Wetness limits the planting and harvesting of trees. Reforestation of areas with desirable species is difficult because of high seedling mortality and severe plant competition. Seedlings grow well if competing vegetation is controlled or removed by good site preparation, spraying, girdling, or mowing.

The soil is severely limited as a site for buildings, sanitary facilities, and recreation uses by the slow or very slow permeability, wetness, ponding, low strength, and high shrink-swell potential. Areas used for these

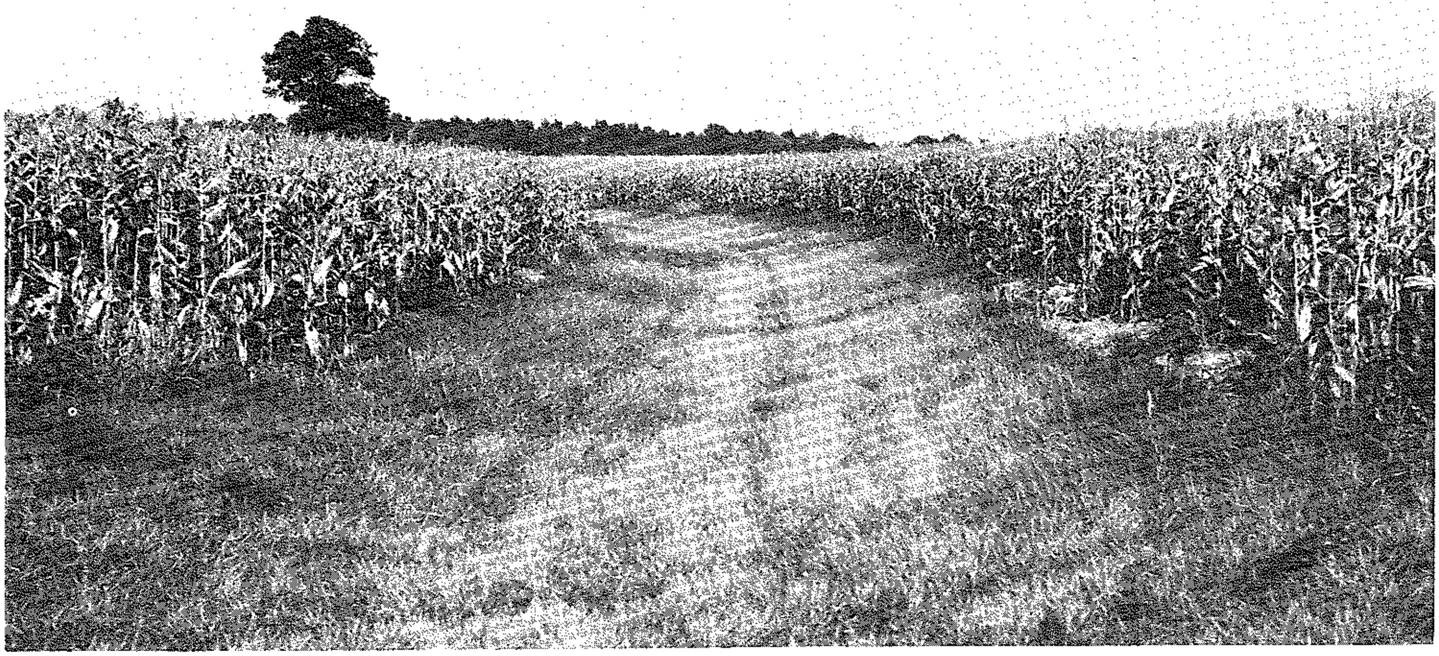

Figure 2.—Grassed waterway on Blount silt loam, 2 to 6 percent slopes.

purposes must be artificially drained. Local roads can also be improved by providing a suitable base material.

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

Ca—Carlisle muck. This nearly level, deep, very poorly drained soil is in slightly concave depressions in uplands and terraces. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are irregularly shaped and 10 to 80 acres.

Typically the surface layer is black, loose muck about 6 inches thick. Below this layer to a depth of about 60 inches is black, dark reddish brown, and dark brown, very friable muck.

Included with this soil in mapping and making up about 5 percent of most areas are very poorly drained Bono, Lenawee, and Linwood soils commonly on the periphery of mapped areas.

Water is near the surface and ponds for long periods. Permeability ranges from moderately slow to moderately rapid. The available water capacity is very high. Organic matter content is very high. The deep root zone is medium acid to neutral.

Most areas are in wetland vegetation and provide habitat for wetland wildlife. Drained areas have potential for row crops and some specialty crops. The potential is low for most building site development, sanitary facilities, and recreation. It is high for wetland wildlife habitat.

Very poor natural drainage and flooding limit this soil for farming. Surface and subsurface drains are effective, but suitable outlets for subsurface drains are difficult to establish in most areas. Subsidence or shrinkage occurs as the result of the 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 amount of shrinkage. During dry periods, soil blowing and the risk of fire are major concerns in areas used for cultivated crops.

Unless drained, this soil is very poorly suited to trees. Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. Wetness severely limits the use of logging equipment.

This soil is severely limited as a site for building development, sanitary facilities, and recreation uses because of ponding, low strength, wetness, and seepage. Removing the organic deposit, adding a suitable base material, and providing drainage can improve local roads. This soil is a source of peat. Undrained areas provide good habitat for ducks, muskrats, and other wetland wildlife.

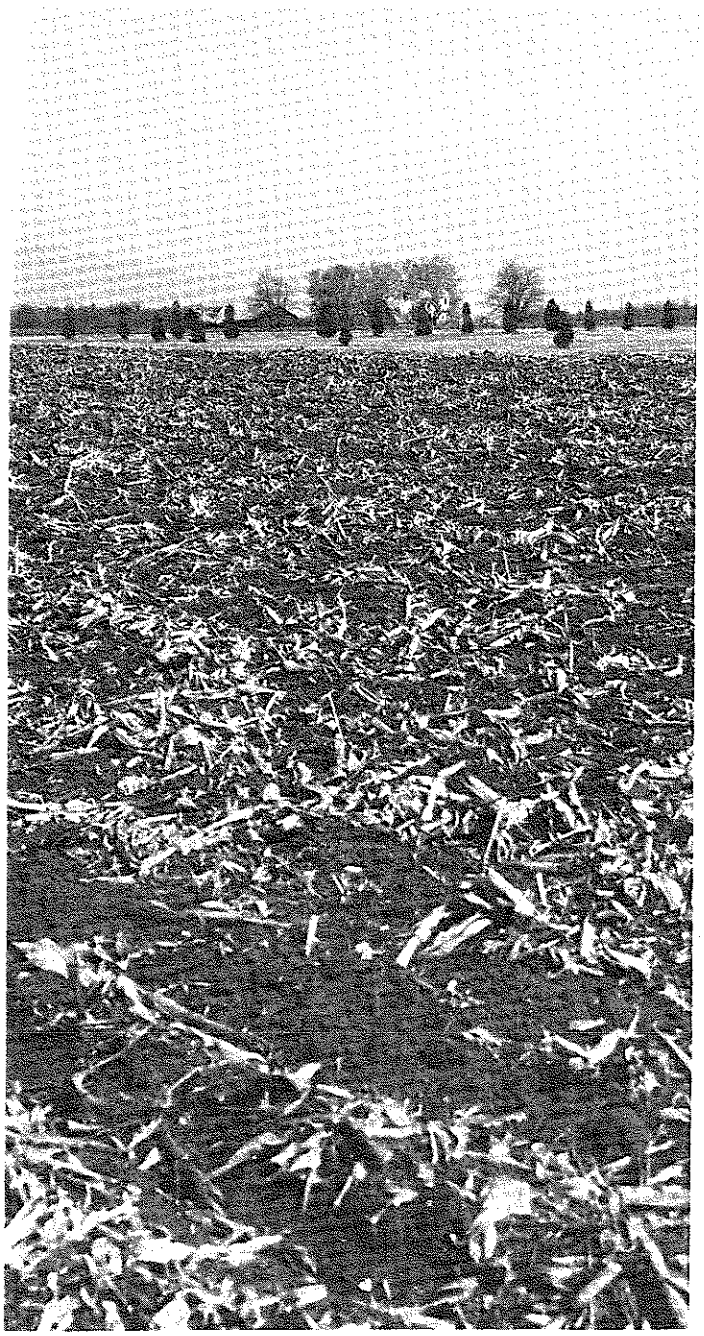

Figure 3.—Crop residue helps to prevent erosion on Blount silt loam, 2 to 6 percent slopes.

The capability subclass is Vw. The woodland suitability subclass is 4w.

Ch—Chagrin silt loam, occasionally flooded. This nearly level, deep, well drained soil is on narrow to broad flood plains. Occasional flooding may occur anytime of the year but generally occurs for brief periods in fall, winter, and spring. Slope is 0 to 2 percent. Most areas range from 3 to 20 acres. Some are as much as 150 acres.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is dark yellowish brown, firm silt loam about 19 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, friable silt loam.

Included with this soil in mapping are narrow strips of somewhat poorly drained Shoals soils in slight depressions and in high water channels. Also included are small areas of soils along Honey Creek where bedrock is at a depth of 20 to 40 inches. Included soils make up about 15 percent of most areas.

Permeability is moderate, and the available water capacity is high. Organic matter content is moderate. Runoff is slow. The subsoil is medium acid to neutral. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The root zone is deep.

Most areas are farmed. This soil has high potential for row crops, pasture, and woodland and as a source of topsoil. It has low potential for most building site development and sanitary facilities. It has medium or high potential for most kinds of recreation.

This soil is suited to row crops year after year and to hay and pasture. In most years, row crops can be planted and harvested during the nonflood periods. Winter grain crops are limited by flooding. Dikes can be used to help prevent flooding in some areas. Minimizing tillage, using crop residue, and planting cover crops maintain tilth, reduce crusting, and protect the surface layer in areas subject to scouring during floods.

This soil is well suited to trees and other vegetation grown as habitat for wildlife. Tree seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

This soil is severely limited for most building site development and sanitary facilities by the flood hazard. Diking to control flooding is difficult. Filling elevates roads above normal flood levels. The soil has potential for such recreation uses as picnic areas, hiking trails, and golf fairways.

The capability subclass is IIw. The woodland suitability subclass is 1o.

CnA—Channahon silt loam, 0 to 2 percent slopes. This nearly level, shallow, well drained soil is on bedrock controlled landscapes of the uplands. Most areas are long and narrow and 5 to 20 acres.

Typically, the surface layer is very dark brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown, friable silt loam and silty clay loam about 10 inches thick. Limestone bedrock is at a depth of about 16 inches. In some areas along streams, slope is 2 to 4 percent. In the vicinity of Flat Rock, the limestone bedrock is fractured to a depth of 2 feet or more.

Included with this soil in mapping are small areas of moderately deep Milton soils on slight rises and moderately deep Randolph and Millsdale soils on flats and in lower lying areas. Also included are small areas of very droughty soils that have a sandy loam surface layer. Included soils make up about 15 percent of most areas.

Permeability is moderate, and the available water capacity is very low. Organic matter content is high. Runoff from cultivated areas is low. The subsoil is neutral. The root zone is shallow over limestone bedrock.

Most areas are in hay or pasture. The potential is low for row crops and medium for hay and pasture. It is low for most kinds of building site development and sanitary facilities. It is medium or low for recreation uses.

This soil is not well suited to row crops because it is droughty. If cultivated, the cropping system should include close-growing crops and grasses and legumes. The surface layer can be worked throughout a fairly wide range of moisture content. Minimum tillage, cover crops, and grassed waterways reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the capacity of the soil to hold water, improves tilth, reduces crusting, and improves the soil-seed contact.

Drought resistant grasses and legumes can be grown for pasture or hay. This soil is well suited to grazing early in spring, but pastures dry up in the dry summer months. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is suited to drought-tolerant trees and shrubs. Tree seedlings are difficult to establish in most years. Growth can be improved if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities by the shallow depth to bedrock. Blasting is generally needed to excavate basements and install underground utilities. The effluent from sanitary facilities can move through fissures in the limestone and pollute underground water supplies. The soil is better suited to houses without basements than to houses with basements. It is suited to such recreation uses as paths and trails.

The capability subclass is IIIs; this soil is not assigned to a woodland suitability subclass.

CnB—Channahon silt loam, 2 to 6 percent slopes. This gently sloping, shallow, well drained soil is on bedrock controlled landscapes of the uplands. Most areas are long and narrow and 5 to 20 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown, friable silt loam and silty clay loam about 8 inches thick. Limestone bedrock is at a depth of about 14 inches. In the vicinity of Flat Rock, the limestone bedrock is fractured to a depth of 2 feet or more.

Included with this soil in mapping are small areas of moderately deep Milton soils on the upper parts of slopes and moderately deep, somewhat poorly drained Randolph soils on flats and in slight depressions. Included soils make up about 15 percent of most areas.

Permeability is moderate, and the available water capacity is very low. Organic matter content is high. Runoff from cultivated areas is medium. The subsoil is neutral. The root zone is shallow over limestone bedrock.

Most areas are in hay or pasture. The potential is low for row crops and medium for hay and pasture. It is low for most kinds of building site development and sanitary facilities. It is medium or low for recreation uses.

This soil is not well suited to row crops because it is droughty. If cultivated, the cropping system should include close-growing crops and grasses and legumes. The surface layer can be worked throughout a fairly wide range of moisture content. Minimum tillage, cover crops, and grassed waterways reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the capacity of the soil to hold water, improves tilth, reduces crusting, and improves the soil-seed contact.

Drought resistant grasses and legumes can be grown for pasture or hay. This soil is well suited to grazing early in spring, but pastures dry up in the dry summer months. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and soil in good condition.

This soil is suited to drought-tolerant trees and shrubs. A few small areas are in native hardwoods. Tree seedlings are difficult to establish in most years. Growth can be improved if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities by the shallow depth to bedrock. Blasting is generally needed to excavate basements and install underground utilities. The effluent from sanitary facilities can move through fissures in the limestone and pollute underground water supplies. The soil is better suited to houses without basements than to houses with basements. It is suited to such recreation uses as paths and trails.

The capability subclass is IIIe. This soil is not assigned to a woodland suitability subclass.

Co—Colwood silt loam. This nearly level, deep, very poorly drained soil is on lake plains, outwash plains, and deltas. It is subject to ponding in the lower parts of depressions from runoff from adjacent higher lying soils.

Slope is 0 to 2 percent. Most areas are long and narrow and 5 to 200 acres.

Typically, the surface layer is very dark gray, friable silt loam about 11 inches thick. The subsoil is about 41 inches thick. The upper and middle parts are dark gray and grayish brown, mottled, friable and firm silty clay loam, and the lower part is grayish brown, mottled, friable stratified fine sand and silt loam with lenses of very fine sand. The substratum to a depth of about 60 inches is brown, mottled, firm fine sandy loam.

Included with this soil in mapping are small areas of somewhat poorly drained Kibbie soils on slight rises; very poorly drained Millgrove soils at the base of beach ridges; and Millsdale and Randolph soils, in which limestone bedrock is at a depth of 20 to 40 inches, on bedrock controlled landscapes. Also included are areas of very poorly drained Hoytville soils on lake plains. Included soils make up about 15 percent of most areas.

Permeability is moderate. Organic matter content is high. The available water capacity is high. Runoff is very slow or ponded. The subsoil is dominantly neutral or mildly alkaline. Tilth is good. The seasonal high water table is near the surface in fall, winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is low for most kinds of building site development, sanitary facilities, and recreation uses.

This soil is suited year after year to row crops, such as corn and soybeans, if management is optimum. It is also well suited to wheat, oats, specialty crops, and grasses and legumes for hay and pasture. Wetness is the main limitation in farming. Unless adequate drainage is provided, poor stands of wheat and oats can be expected in most years. Surface drains are commonly needed. Subsurface drains are used to lower the seasonal high water table, but suitable outlets are difficult to establish in some areas. Timely tillage is important to reduce compaction. Minimum tillage and cover crops are good management practices especially if this soil is used for row crops year after year. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth, reduces crusting, and improves the soil-seed contact.

Even if this soil is drained, controlled grazing is a good practice. The surface layer compacts easily if the soil is pastured when soft and sticky as a result of wetness. Pasture rotation and restricted grazing during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to water-tolerant trees and shrubs. A few small areas support native hardwoods. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Wetness limits the use of planting and harvesting equipment in winter and spring.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of wetness, ponding, and low strength. Surface drains and storm sewers are needed. Subsurface drains are also used to lower the seasonal high water table. Local roads and streets can be improved by providing suitable base material. Excavation is limited in winter and spring by the seasonal high water table.

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

DmA—Digby loam, 1 to 4 percent slopes. This nearly level and gently sloping, deep, somewhat poorly drained soil is in irregularly shaped areas on stream terraces and beach ridges. Most areas are 4 to 60 acres.

Typically, the surface layer is dark grayish brown and dark brown, friable loam about 10 inches thick. It is mottled in the lower part. The subsoil is about 27 inches thick. It is brown, grayish brown, and dark grayish brown, mottled, friable and firm sandy clay loam, clay loam, and gravelly sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown, dark gray, and grayish brown, mottled, friable sandy loam.

Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderate. Runoff is slow. The subsoil is slightly acid or medium acid in the upper part and neutral or mildly alkaline in the lower part. The seasonal high water table is at a depth of 12 to 30 inches in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for cultivated crops, small grain, hay, pasture, and trees. It is low for most kinds of building site development and sanitary facilities. It is medium for many kinds of recreation.

This soil is suited to corn, soybeans, wheat, and oats. Wetness is the main limitation in farming. Surface and subsurface drains are commonly needed. Minimum tillage and deep rooted cover crops help to improve natural drainage. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact. Tilling and harvesting are best performed at optimum moisture levels with equipment that minimizes soil compaction.

This soil is suited to pasture and hay but is poorly suited to grazing early in spring. Surface compaction, poor tilth, reduced growth, and decreased infiltration rates result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

The seasonal wetness and hazard of polluting underground water supplies severely limit the use of this soil as a site for buildings and most kinds of sanitary facilities. Artificial drains are effective in most areas. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective exterior wall coatings help to keep basements dry. Excavations are limited in winter and spring because of the seasonal high water table and sloughing of banks. Local roads and streets can be improved by providing artificial drainage and suitable base material. Wetness also limits recreation uses.

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

FcA—Fitchville silt loam, 1 to 4 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is on terraces and in basins of former lakes. Most areas are irregular in shape and 4 to 80 acres.

Typically, the surface layer is dark grayish brown and dark brown, friable silt loam about 8 inches thick. It is mottled in the lower part. The subsoil is about 48 inches thick. The upper part is yellowish brown and grayish brown, mottled, friable and firm silty clay loam, and the lower part is brown and yellowish brown, mottled, firm silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of very poorly drained Colwood soils in depressions and somewhat poorly drained Nappanee soils on flats of the lake plain. Also included are small areas of this Fitchville soil on stream terraces that are subject to occasional flooding. Included soils make up about 5 percent of most areas.

Permeability is moderately slow. The available water capacity is high. Organic matter content is moderate. Runoff is slow. The subsoil generally ranges from strongly acid in the upper part to neutral in the lower part. The surface layer crusts after heavy rains. The seasonal high water table is at a depth of 12 to 30 inches in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for cultivated crops, hay, pasture, and trees. It is low for most kinds of building site development and sanitary facilities. It is medium for most kinds of recreation uses.

Drained areas of this soil are well suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. Seasonal wetness is the main limitation in farming. The soil warms slowly and dries late in spring in undrained areas. Subsurface drainage systems are commonly used to remove excess water from the root zone. Surface drains are effective in some areas. Returning crop residue to the soil or adding other organic matter and planting cover crops improve tilth, reduce crusting, and help to control erosion.

This soil is poorly suited to grazing early in spring. Overgrazing or grazing when soft and sticky as a result of wetness causes poor tilth because the surface layer compacts easily. Pasture rotation and restricted grazing during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas support native hardwoods. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities and moderately limited for most kinds of recreation uses because of moderately slow permeability, seasonal wetness, and low strength. Drainage can be improved by subsurface drains and open ditches. Local roads can be improved by artificial drainage and using suitable base material. Building sites should be graded to provide good surface drainage away from the foundation. Excavations are limited by wetness in winter and spring.

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

GaA—Gallman loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is in broad areas on stream terraces and outwash plains. Most areas are irregular in shape and 10 to 50 acres.

Typically, the surface layer is dark brown, friable loam about 10 inches thick. The subsoil to a depth of about 50 inches is dark yellowish brown and dark brown, friable loam in the upper part and dark brown, friable gravelly clay loam and gravelly sandy clay loam in the lower part. In some areas along Honey Creek, limestone bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of moderately well drained Haney soils and somewhat poorly drained Digby soils in lower lying positions. Included soils make up about 10 percent of most areas.

Permeability is moderately rapid. The available water capacity is moderate. Organic matter content is moderate. Runoff is slow. Reaction ranges from very strongly acid to neutral in the upper part of the subsoil and from medium acid to neutral in the lower part. The root zone is deep.

Most areas are farmed. The potential is high for cultivated crops, small grain, and trees. It is high for most kinds of building site development and recreation. It is low for water impoundments and some kinds of sanitary facilities because the subsoil is moderately rapidly permeable.

This soil is well suited year after year to row crops, such as corn and soybeans, and to specialty crops. It is also suited to small grain. It dries early in spring, and the surface layer can be worked throughout a fairly wide range of moisture content. It is suited to irrigation. Minimum tillage and deep rooted cover crops are good management practices, especially if the soil is used for row crops year after year. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration and improves tilth and fertility. Because plant nutrients are leached at a moderately rapid rate, smaller, more frequent or timely applications of fertilizer and lime are more suitable than one large application.

This soil is well suited to grazing early in spring and to deep rooted grasses and legumes for pasture and hay. Proper stocking, plant selection, pasture rotation, and weed control help to keep the pasture and the soil in good condition.

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

This soil is well suited as a site for most kinds of buildings and recreation. Local roads can be improved by providing suitable base material. Sanitary facilities, such as sewage lagoons, are limited by the possible pollution of underground water supplies.

The capability class is I. The woodland suitability subclass is 1o.

GaB—Gallman loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is in irregularly shaped areas on low knolls and in long strips on stream terraces, outwash plains, and end moraines. Most areas are 10 to 50 acres.

Typically, the surface layer is dark brown, friable loam about 10 inches thick. The subsoil to a depth of about 50 inches is dark yellowish brown and dark brown, friable loam in the upper part and dark brown, friable gravelly clay loam and gravelly sandy clay loam in the lower part. In some areas along Honey Creek, limestone bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of moderately well drained Haney soils and somewhat poorly drained Digby soils in lower lying positions. Included soils make up about 10 percent of most areas.

Permeability is moderately rapid. The available water capacity is moderate. Organic matter content is moderate. Runoff is medium. Reaction ranges from very strongly acid to neutral in the upper part of the subsoil and from medium acid to neutral in the lower part. The root zone is deep.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is high for most kinds of building site development and recreation uses. It is low for some kinds of sanitary facilities and for water impoundments because the subsoil is moderately rapidly permeable.

This soil is suited to corn, soybeans, wheat, oats, hay, and specialty crops. Erosion is the main hazard in growing row crops. Row crops can be grown year after year if erosion is controlled. The surface layer can be worked throughout a fairly wide range of moisture content. The soil dries early in spring and is well suited to tillage early in spring. It is suited to irrigation. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth, reduces the risk of erosion, reduces crusting, and improves the soil-seed contact. Because plant nutrients are leached at a moderately rapid rate, smaller, more frequent or timely applications of fertilizer and lime are more suitable than one large application.

This soil is well suited to grazing early in spring and to deep rooted grasses and legumes for hay and pasture. Proper stocking, plant selection, pasture rotation, and weed control help to keep the pasture and the soil in good condition.

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

This soil is well suited as a site for buildings and recreation uses. Local roads and streets can be improved by providing suitable base material. Seepage from sanitary facilities can pollute underground water supplies, especially if the soil is used for trench sanitary landfills or sewage lagoons.

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

GwA—Glynwood silt loam, 0 to 2 percent slopes. This nearly level, deep, moderately well drained soil is on broad flats of the uplands. Most areas are irregular in shape and 10 to 250 acres.

Typically, the surface layer is dark brown, friable silt loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown and dark yellowish brown, mottled, firm silty clay loam and clay loam, and the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Blount and Haskins soils in some of the more level areas. Also included are very poorly drained Pewamo and poorly drained Pandora soils in narrow drainageways and moderately deep, well drained Milton soils on slight rises. Included soils make up about 15 percent of most areas.

Permeability is slow. The available water capacity is moderate. Organic matter content is moderate. Runoff is slow. The subsoil is very strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The surface layer can be worked throughout a fairly wide range of moisture content. The root zone is restricted below a depth of 22 to 40 inches by compact, calcareous glacial till. The seasonal high water table is perched at a depth of 24 to 42 inches in winter, spring, and other extended wet periods.

Most areas are farmed. The potential is high for row crops and small grain. It is medium for most kinds of building site development and sanitary facilities and medium to high for recreation.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. Cultivated crops can be grown frequently if management is good. Maintaining good tilth and high fertility are major management concerns. Compaction is a concern if the soil is tilled when soft and sticky as a result of wetness. Minimizing tillage, planting cover crops, incorporating crop residues, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the risk of erosion. Randomly spaced subsurface drains are needed in areas of the included, wetter soils.

Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Pasture rotation and restricted grazing during wet periods help to keep the pasture and the soil in good condition.

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

Seasonal wetness, slow permeability, and shrink-swell potential limit this soil as a site for buildings and sanitary facilities. Ditches to control the seasonal high water table are somewhat effective. The soil is better suited to houses without basements than to houses with basements. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective exterior wall coatings help to prevent wet basements. Local roads can be improved by artificial drainage and using suitable base material to overcome the risk of damage caused by frost action and low strength.

The capability class is I. The woodland suitability subclass is 2o.

GwB—Glynwood silt loam, 2 to 6 percent slopes. This gently sloping, deep, moderately well drained soil is on knolls, ridges, and on side slopes at the heads of drainageways on uplands. Most areas are irregular in shape and 10 to 250 acres.

Typically, the surface layer is dark brown, friable silt loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown and dark yellowish brown, mottled, firm silty clay loam and silty clay, and the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Blount soils on the lower part of slopes. Small areas of an eroded soil on the upper parts of slopes have a silty clay loam surface layer and fair tilth. Narrow strips of the poorly drained Pandora soils are in narrow drainageways. These soils make up about 15 percent of most areas. Also included in the southwestern corner of the county are well drained soils that have less clay in the subsoil and substratum. These soils have a clay loam subsoil and a silt loam or loam substratum and are moderately slowly permeable.

Permeability is slow. The available water capacity is moderate. Organic matter content is moderate. Runoff is medium. The subsoil is very strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The surface layer can be worked throughout a fairly wide range of moisture content. The root zone is restricted below a depth of 22 to 40 inches by compact, calcareous glacial till. The seasonal high water table is perched at a depth of 24 to 42 inches in winter, spring, and other extended wet periods.

Most areas are farmed. The potential is high for row crops and small grain. It is medium for most kinds of building site development and sanitary facilities and medium to high for recreation uses.

This soil is suited to row crops and small grain. Erosion is the main hazard if cultivated crops are grown. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer improves tilth and fertility, increases the rate of water infiltration, reduces crusting, and improves the soil-seed contact. Randomly spaced subsurface drains are needed in areas of the wetter, included soils.

Using this soil for pasture or hay effectively controls erosion. Surface compaction, reduced growth, poor tilth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

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

Seasonal wetness, shrink-swell potential, and slow permeability are moderate limitations for most kinds of building site development and sanitary facilities. These limitations can be partly or fully overcome by specially designed facilities. If properly designed and installed, artificial drainage effectively reduces wetness and the shrink-swell potential in places. The soil is better suited to houses without basements than to houses with basements. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective exterior wall coatings will help to prevent wet basements. The increased runoff and erosion that occur during construction can be reduced by maintaining a plant cover wherever possible. Septic tank absorption fields can be improved by increasing the size of the field. This soil is suited to such recreation uses as picnic areas and hiking trails.

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

GxB2—Glynwood silty clay loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, moderately well drained soil is on convex slopes on the top and sides of knolls and ridges on the uplands. Erosion has removed part of the original surface layer. The present surface layer contains subsoil material that has more coarse fragments and is higher in clay content. Most areas are long and narrow and 5 to 60 acres.

Typically, the surface layer is dark brown, firm silty clay loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, firm silty clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam and clay loam. The surface layer is silt loam or loam in some areas.

Included with the soil in mapping are small areas of somewhat poorly drained Blount and Haskins soils on the lower parts of slopes and on the broader ridgetops. Also included are poorly drained Pandora soils in narrow drainageways. Included soils make up about 10 percent of most areas.

Permeability is slow. The available water capacity is moderate. Organic matter content is moderately low. Runoff is medium. The subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The surface layer can be worked only within a narrow range of moisture content. The root zone is restricted below a depth of 22 to 30 inches by compact, calcareous glacial till. The seasonal high water table is perched at a depth of 24 to 42 inches in winter, spring, and other extended wet periods.

Most areas are farmed. The potential is medium for row crops and small grain and for most kinds of building site development, sanitary facilities, and recreation uses.

This soil is suited to corn, soybeans, wheat, and oats. Further erosion is the main hazard for cultivated crops (fig. 4). Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact. Randomly spaced subsurface drains are needed in areas of the included, wetter soils.

Using this soil for pasture or hay effectively controls erosion. Surface compaction, poor tilth, reduced growth, and increased runoff can result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is suited to trees. Seedlings survive and grow well if competing vegetation is controlled or removed. Survival and growth can be improved by good site preparation.

Seasonal wetness, slow permeability, and shrink-swell potential are moderate limitations for building sites and sanitary facilities. The soil is better suited to houses without basements than to houses with basements. Foundation drains and protective exterior wall coatings help to prevent wet basements. The increased runoff and erosion that occur during construction can be reduced by maintaining a plant cover wherever possible. Local roads can be improved by artificial drainage and using suitable base material. The soil is suited to such recreation uses as picnic areas and hiking trails. It is also suitable for pond embankments.

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

Figure 4.—Severe gully that developed in winter and spring in a natural waterway. The soil is Glynwood silty clay loam, 2 to 6 percent slopes, eroded.

GxC2—Glynwood silty clay loam, 6 to 12 percent slopes, eroded. This sloping, deep, moderately well drained soil is on convex ridgetops and side slopes, and in long narrow areas along well defined waterways in the uplands. Erosion has removed part of the original surface layer. The present surface layer contains subsoil material that has more coarse fragments and is higher in clay content. Most areas are 2 to 20 acres.

Typically, the surface layer is brown, friable silty clay loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, firm silty clay loam; the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam and clay loam. The surface layer is silt loam or loam in some areas.

Included with this soil in mapping are small areas of gently sloping, somewhat poorly drained Blount soils and narrow strips of poorly drained Pandora soils along drainageways. Included soils make up about 15 percent of most areas.

Permeability is slow. The available water capacity is moderate, although it has been reduced by erosion. Organic matter content is moderately low. Runoff from cultivated areas is rapid. The subsoil is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The root zone is restricted below a depth of 22 to 30 inches by compact, calcareous glacial till. The seasonal high water table is perched at a depth of 24 to 42 inches in winter and spring and in other extended wet periods.

Most areas are farmed. The potential is medium for row crops, small grain, building site development, sanitary facilities, and many kinds of recreation uses.

This soil is suited to corn, soybeans, and small grain. The hazard of further erosion is severe in cultivated areas. Grasses and legumes in the cropping system help to control erosion and maintain tilth. The surface layer crusts after hard rains. If plowed when wet and sticky, the soil is cloddy. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer improves tilth and fertility, increases the rate of water infiltration, reduces crusting, and improves the soil-seed contact.

Surface compaction, reduced growth, poor tilth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs. A few areas support native hardwoods. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging roads should be protected against erosion.

Seasonal wetness, slope, shrink-swell potential, and slow permeability are moderate to severe limitations for most building site development, sanitary facilities, and recreation. These limitations can be partly or fully overcome by specially designed facilities. In places artificial drainage is effective if properly designed and installed. Local roads can be improved by using suitable base material. Foundation drains and protective exterior wall coatings help to prevent wet basements. The increased runoff and erosion that occur during construction can be reduced by maintaining a plant cover wherever possible.

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

HaA—Haney loam, 0 to 2 percent slopes. This nearly level, deep, moderately well drained soil is on stream terraces, beach ridges, and outwash plains. Most areas are long and narrow or irregular in shape and 2 to 80 acres.

Typically, the surface layer is dark brown, friable loam about 11 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, mottled, friable loam and sandy clay loam, the middle part is dark yellowish brown, mottled, firm gravelly clay loam, and the lower part is dark brown, mottled, very friable gravelly sandy clay loam. The substratum to a depth of about 60 inches is yellowish brown and dark grayish brown, mottled, loose and very friable gravelly sandy loam and sandy loam.

Included with this soil in mapping and making up about 10 percent of most areas are small areas of somewhat poorly drained Digby soils in depressions.

Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderate. Runoff is slow. Reaction ranges from strongly acid to slightly acid in the upper and middle parts of the subsoil and from slightly acid to mildly alkaline in the lower part. The seasonal high water table is at a depth of 24 to 42 inches in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for row crops, small grain, and hay. It is medium for most kinds of building site development and medium or high for recreation uses. It is low for water impoundments and some kinds of sanitary facilities.

This soil is suited to corn, soybeans, and small grain. The surface layer can be worked throughout a fairly wide range of moisture content. Minimum tillage and deep rooted cover crops are good management practices, especially if the soil is used for row crops year after year. The soil is well suited to irrigation. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact. Randomly spaced subsurface drains are needed in areas of the included, wetter soils.

This soil is well suited to pasture and hay. Surface compaction, poor tilth, reduced growth, and decreased infiltration rates result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs. A few areas along streams are used for native hardwoods. Plant competition can be reduced by cutting, spraying, girdling, or mowing.

Seasonal wetness and seepage are limitations for building sites, sanitary facilities, and recreation uses. These limitations can be partly or fully overcome by using specially designed facilities. The seepage from sanitary facilities, such as sewage lagoons and sanitary landfills, can result in pollution of underground water supplies. The soil is better suited to houses without basements than to houses with basements. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective exterior wall coatings help to keep basements dry.

Local roads and streets can be improved by providing artificial drainage and a suitable base material to reduce the damage from frost action.

The capability class is I. The woodland suitability subclass is 2o.

HaB—Haney loam, 2 to 6 percent slopes. This gently sloping, deep, moderately well drained soil is on beach ridges, stream terraces, and outwash plains. It is in irregularly shaped areas on slight rises and in long and narrow strips on slope breaks. Most areas are 2 to 100 acres.

Typically, the surface layer is dark brown, friable loam about 11 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable loam and sandy clay loam, and the lower part is dark yellowish brown and dark brown, mottled, firm and friable gravelly clay loam and gravelly sandy clay loam. The substratum to a depth of about 60 inches is yellowish brown and dark grayish brown, mottled, loose and very friable gravelly sandy loam and sandy loam.

Included with this soil in mapping and making up about 10 percent of most areas are small areas of somewhat poorly drained Digby soils in depressions.

Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderate. Runoff is medium. Reaction ranges from strongly acid to slightly acid in the upper and middle parts of the subsoil and from slightly acid to mildly alkaline in the lower part. The seasonal high water table is at a depth of 24 to 42 inches in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is medium for most kinds of building site development and medium to high for recreation uses. It is low for water impoundments and some kinds of sanitary facilities.

This soil is suited to corn, soybeans, wheat, and oats. Erosion can be controlled in most areas through a good management program. The soil is suited to irrigation. The surface layer can be worked throughout a fairly wide range of moisture content. In most areas contour tillage is not feasible because the slopes are short and irregular. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact. Randomly spaced subsurface drains are needed in areas of the included, wetter soils.

The soil is suited to grasses and legumes grown for pasture or hay. Surface compaction, poor tilth, reduced growth, and decreased infiltration result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs. A few areas near steeper soils support native hardwoods. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Survival and growth can be improved by good site preparation.

Seasonal wetness and seepage are limitations for building sites, sanitary facilities, and recreation uses. These limitations can be partly or fully overcome by specially designed facilities. The seepage from sanitary facilities, such as sewage lagoons and sanitary landfills, can result in pollution of underground water supplies. The soil is better suited to houses without basements than to houses with basements. Building sites should be graded to provide good surface drainage away from the foundations. Foundation drains and protective exterior wall coatings help to keep basements dry. Installing artificial drainage and using suitable base material under roads reduce the damage from frost action.

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

HaC2—Haney loam, 6 to 12 percent slopes, eroded. This sloping, deep, moderately well drained soil is on convex ridges and side slopes of beach ridges and terraces. Erosion has removed part of the original surface layer. The present surface layer contains subsoil material that has more coarse fragments and is higher in clay content. Most areas are 2 to 50 acres.

Typically, the surface layer is dark brown, friable loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable loam and sandy clay loam, and the lower part is yellowish brown, mottled, friable gravelly clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, very friable gravelly sandy loam and sandy loam.

Included with this soil in mapping and making up about 10 percent of most areas are small areas of somewhat poorly drained Digby and Haskins soils on foot slopes.

Permeability is moderate in the subsoil and rapid in the substratum. The available water capacity is moderate. Organic matter content is moderately low. Runoff from cultivated areas is rapid. Reaction ranges from strongly acid to slightly acid in the upper and middle parts of the subsoil and from slightly acid to mildly alkaline in the lower part. The seasonal high water table is at a depth of 24 to 42 inches in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is medium for cultivated crops, building site development, and many kinds of recreation. It is high for hay, pasture, and trees.

This soil is moderately well suited to cultivated crops and small grain. Further erosion is the main hazard for row crops. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer improves tilth and fertility, increases the rate of water infiltration, reduces crusting, and improves the soil-seed contact. The surface layer can be worked throughout a fairly wide range of moisture content. Artificial drainage is needed in some seep areas.

Using this soil for pasture or hay effectively controls erosion. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging roads should be protected against erosion.

Seasonal wetness, seepage, and slope are limitations for building sites, sanitary facilities, and recreation uses. These limitations can be partly or fully overcome by specially designed facilities. The seepage from sanitary facilities, such as sewage lagoons and sanitary landfills, can result in pollution of underground water supplies. In most places artificial drainage is effective. Foundation drains and protective exterior wall coatings help to keep basements dry. Installing artificial drainage and using suitable base material under roads reduce the damage from frost action. If the soil is used as a construction site, development should be on the contour if possible.

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

HkA—Haskins loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is in irregularly shaped areas on stream terraces, beach ridges, and till plains. Most areas are 2 to 30 acres.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown, mottled, friable loam, the middle part is yellowish brown and brown, mottled, firm, clay loam and gravelly clay loam, and the lower part is yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, very firm silty clay loam.

Included with this soil in mapping are small areas of moderately well drained Rawson soils on slight rises and poorly drained Pandora soils in drainageways. Included soils make up about 10 percent of most areas.

Permeability is moderate in the upper and middle parts of the subsoil and slow or very slow in the lower part and in the substratum. Runoff is slow. The available water capacity is moderate. Organic matter content is moderate. The subsoil is slightly acid to strongly acid in the upper part and slightly acid to mildly alkaline in the lower part. The seasonal high water table is perched at a depth of 12 to 30 inches in winter, spring, and other extended wet periods.

Most areas are farmed. The potential is high for corn, soybeans, small grain, hay, pasture, and trees. It is low for most kinds of building site development and sanitary facilities and medium for recreation uses.

This soil is suited to corn, soybeans, small grain, pasture, and hay. The main limitation in farming is seasonal wetness. Surface drains are needed. A subsurface drainage system is commonly used to 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. Using crop residues, adding other organic material regularly, and planting cover crops improve tilth and reduce surface crusting.

Overgrazing or grazing when this soil is soft and sticky as a result of wetness causes surface compaction and poor tilth. Pasture rotation and restricted grazing during wet periods help to keep the pasture and the soil in good condition.

Undrained areas of this soil are suited to woodland. Species that can tolerate some wetness should be selected for new plantings. The use of harvesting equipment is limited during wet seasons. Reforestation with desirable species is difficult because of plant competition. Plant competition can be reduced by spraying, mowing, and disking.

The seasonal high water table, slow or very slow permeability, shrink-swell potential, and low strength are severe limitations for sanitary facilities and building sites. Drainage ditches and subsurface drains lower the seasonal high water table. Foundation drains and protective exterior wall coatings help to keep basements dry. Building sites should be graded to provide good surface drainage away from the foundation. Sanitary facilities should be connected to commercial sewers and treatment facilities if possible.

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

HkB—Haskins loam, 2 to 6 percent slopes. This gently sloping, deep, somewhat poorly drained soil is in irregularly shaped areas on stream terraces, beach ridges, and uplands. Most areas are 5 to 100 acres.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil is about 24 inches. The upper part is yellowish brown, mottled, friable loam, the middle part is yellowish brown and brown, mottled, firm clay loam and gravelly clay loam, and the lower part is yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, very firm silty clay loam.

Included with this soil in mapping are small areas of moderately well drained and well drained Rawson soils on convex knolls and poorly drained Pandora soils in drainageways. Included soils make up about 10 percent of most areas.

Permeability is moderate in the upper and middle parts of the subsoil and slow or very slow in the lower part and in the substratum. Runoff is medium. The available water capacity is moderate. Organic matter content is moderate. The subsoil is slightly acid to strongly acid in the upper part and slightly acid to mildly alkaline in the lower part. The seasonal high water table is perched at a depth of 12 to 30 inches in winter, spring, and other extended wet periods.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is low for most kinds of building site development and sanitary facilities and medium for recreation.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Seasonal wetness and the erosion hazard are the main concerns of management. Most cropped areas are drained by a system of randomly spaced subsurface drains because the landscape is uneven. These drains are more effective if placed on or above the slowly or very slowly permeable glacial till or lacustrine material. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material regularly improves fertility, reduces crusting, and increases water infiltration.

The main concerns in managing pasture are overgrazing and grazing during wet periods. This soil compacts easily, resulting in poor tilth and retarded growth. Pasture rotation and restricted grazing during wet periods help to keep the pasture and the soil in good condition.

Undrained areas are suited to woodland. Species that can tolerate some wetness should be selected for new plantings. Harvesting equipment is limited during wet seasons. Reforestation with desirable species is difficult because of plant competition, which can be reduced by spraying, mowing, or disking.

Seasonal wetness, slow or very slow permeability, low strength, and shrink-swell potential in the lower part of the subsoil and in the substratum are severe limitations for most kinds of sanitary facilities and building site development. Drainage can be improved by installing surface and subsurface drains. Foundation drains and protective exterior wall coatings help to keep basements dry. Local roads can be improved by artificial drainage and using a suitable base material, which overcome the risk of damage caused by frost action and low strength.

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

HmB—Haskins-Seward complex, 2 to 6 percent slopes. This gently sloping map unit occurs as long narrow areas on beach ridges and as oval areas on till plains. It is 60 percent deep, somewhat poorly drained Haskins loam and 30 percent deep, moderately well drained Seward loamy fine sand. Most areas range from 5 to 25 acres. The Haskins soil is mainly on the lower part of slopes, and the Seward soil is on the tops and sides of ridges and knolls. Areas of these soils are so intricately mixed or so small in size that it is not practical to map them separately.

Typically, the Haskins soil has a surface layer of dark grayish brown, friable loam about 7 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown, mottled, firm loam and clay loam and the lower part is brown, mottled, firm silty clay loam and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam. In some areas, the surface layer is fine sandy loam.

Typically, the Seward soil has a surface layer of brown, very friable loamy fine sand about 12 inches thick. The subsoil is about 28 inches thick. The upper part is dark brown and yellowish brown, friable loamy fine sand and fine sandy loam; the lower part is dark brown and yellowish brown, mottled, friable sandy loam and firm silty clay loam. The substratum to a depth of about 60 inches is dark brown, mottled, firm silty clay loam.

Included with this unit in mapping are small areas of somewhat poorly drained Rimer soils in depressions and along drainageways. Also included are areas of more droughty soils on the upper parts of slopes. These soils are sandy to a depth of more than 40 inches. They have a very low available water capacity. Included soils make up about 10 percent of most areas.

The upper and middle parts of the subsoil are moderately permeable in the Haskins soil and rapidly permeable in the Seward soil. The lower part of the subsoil and the substratum are slowly or very slowly permeable in both soils. Runoff is medium from the Haskins soil and slow from the Seward soil. The available water is moderate in the Haskins soil and low in the Seward soil. Organic matter content is moderate in the Haskins soil and moderately low in the Seward soil. Reaction ranges from slightly acid to strongly acid in the upper part of the subsoil of the Haskins soil and slightly acid to mildly alkaline in the lower part. The seasonal high water table is perched at a depth of 12 to 30 inches in the Haskins soil and at 36 to 60 inches in the Seward soil in winter, spring, and other extended wet periods. The root zone is mainly moderately deep in both soils.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. In the Haskins soil it is low for most building site development and sanitary facilities, whereas in the Seward soil, it is medium. In the Haskins soil the potential is medium for recreation use, and in the Seward soil it is medium or high.

The wetness, hazard of erosion and soil blowing, and low available water capacity are limitations in farming. The soils are suited to corn, soybeans, wheat, and oats. The Seward soil dries earlier in spring than the Haskins soil. Most areas of cropland are drained by a random system of subsurface drains because the landscape is uneven. The drains are more effective if placed on or above the slowly or very slowly permeable glacial till or lacustrine material. In the Seward soil, soil blowing mainly occurs in areas that do not have a thick plant cover and in cultivated fields in spring. Both soils are suited to irrigation. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. Returning crop residue or adding other organic material regularly conserves moisture, reduces crusting, and increases water infiltration.

These soils are suited to pasture or hay. Overgrazing or grazing when the soils are soft as a result of wetness causes compaction and poor tilth. Deep rooted grasses and legumes should be selected for planting on the Seward soil because of the low available water capacity. No-till reseeding reduces soil loss on this soil.

These soils are suited to trees and shrubs. Drought-tolerant trees should be selected for planting on the Seward soil because seedlings are difficult to establish during the drier part of the year. Planting should be done early in spring.

The Seward soil is better suited to building sites and recreation uses than the Haskins soil even though seasonal wetness, the high shrink-swell potential, and slow or very slow permeability in the lower part of the subsoil and in the substratum are limitations in both soils. Subsurface drains and storm sewers are needed. Foundation drains and protective exterior wall coatings help to keep basements dry. Septic tank absorption fields can be improved by increasing the size of the field. Lateral movement of water from sanitary facilities over the slowly or very slowly permeable material in the lower part of the subsoil and in the substratum of the Seward soil can adversely pollute ground water supplies. The sandy surface layer of the Seward soil affects most kinds of recreation uses.

The capability subclass is IIe. The woodland suitability subclass is 2o for the Haskins soil and 2s for the Seward soil.

Ht—Hoytville silty clay loam. This nearly level, deep, very poorly drained soil is in broad flats on the lake plain. It receives runoff from adjacent higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are irregular in shape and 50 acres to several hundred acres. Some are more than 600 acres.

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

Included with this soil in mapping are circular, convex areas and bands of somewhat poorly drained Nappanee, Haskins, Kibbie, and Randolph soils. Also included are very poorly drained Lenawee and Millgrove soils in drainageways and very poorly drained Millsdale soils, which are 20 to 40 inches deep over bedrock. Included soils make up about 15 percent of most areas.

Permeability is slow, and the available water capacity is moderate. Organic matter content is high. Runoff is very slow or ponded. Reaction ranges from slightly acid or neutral in the upper part of the subsoil to neutral or mildly alkaline in the lower part. The seasonal high water table is near the surface in winter, spring, and other extended wet periods. The soil is sticky when wet and puddles and clods easily.

Most areas are farmed. The potential is high for row crops and small grain. It is low for building site development, sanitary facilities, and recreation.

Wetness is the main limitation in farming. Drained areas are well suited to corn, soybeans, wheat, and oats. Surface drains are commonly needed. Tillage within a limited range of moisture content is important because the soil becomes compacted and cloddy if worked when wet and sticky. Minimizing tillage, planting cover crops, and incorporating crop residue or other organic matter content into the surface layer help to maintain tilth, increase the rate of water infiltration, improve fertility, reduce crusting, and improve the soil-seed contact.

Drained areas of this soil are suited to pasture or hay. Undrained areas are poorly suited to grazing early in spring. Surface compaction, poor tilth, decreased infiltration, and reduced plant growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Species tolerant of wetness should be used in new seedlings. Proper stocking, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to water-tolerant trees and shrubs. A few small areas are in native hardwoods. Logging and planting are limited by wetness. Seedlings tolerant of wetness and the clayey subsoil grow well if competing vegetation is controlled or removed by good site preparation, spraying, girdling, or mowing.

The soil is severely limited as a site for buildings, sanitary facilities, and recreation uses by slow permeability, wetness, ponding, low strength, and high shrink-swell potential. Areas used for these purposes must be artificially drained. Building sites should be graded to provide good surface drainage away from the foundation. Local roads can be improved by artificial drainage and using a suitable base material.

The capability subclass is IIw. The woodland suitability subclass is 3w.

KbA—Kibbie fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in former lake basins. Most areas are irregular in shape and 10 acres to several hundred acres. Some are more than 500 acres.

Typically, the surface layer is very dark gray, friable fine sandy loam about 8 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, mottled, friable sandy clay loam and loam, and the lower part is dark brown and brown, mottled, friable sandy clay loam. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled, friable stratified silt loam and very fine sandy loam.

Included with this soil in mapping are small areas of somewhat poorly drained Fitchville soils on slight rises and very poorly drained Hoytville soils in depressions. Included soils make up about 10 percent of most areas.

Permeability is moderate, and the available water capacity is high. Organic matter content is moderate.

Runoff is slow. The subsoil is slightly acid or neutral. Tilth is good. The seasonal high water table is at a depth of 12 to 24 inches in fall, winter, spring, and other extended wet periods.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is low for most kinds of building site development and sanitary facilities. It is medium for many kinds of recreation uses.

This soil is suited to corn, soybeans, wheat, and oats. Wetness is the main limitation in farming. Surface and subsurface drains are commonly needed, but suitable outlets are difficult to establish in some areas. The soil is easy to till. Minimum tillage and deep rooted cover crops help to improve natural drainage. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact.

This soil is suited to pasture or hay, but it is poorly suited to grazing early in spring. Surface compaction, poor tilth, reduced growth, and decreased infiltration result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas along streams support native hardwoods. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

Seasonal wetness is a severe limitation to building sites and sanitary facilities. Artificial drains are effective in most areas. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective wall coatings help to keep basements dry. Local roads and streets can be improved by providing artificial drainage and suitable base material. Wetness also limits recreation uses.

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

Le—Lenawee silty clay loam. This nearly level, deep, very poorly drained soil is on flat and in depressional areas of slack water basins. It is subject to ponding from runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are long and narrow or irregular in shape and 5 to 20 acres. Some are as much as 50 acres.

Typically, the surface layer is very dark gray, firm silty clay loam about 9 inches thick. The subsoil is about 44 inches thick. The upper part is dark grayish brown and gray, mottled, firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam and clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam. In a few small areas, the surface layer is silt loam or silty clay.

Included with this soil in mapping and making up about 5 percent of most areas are small areas of poorly drained Pandora and very poorly drained Bono soils in drainageways.

Permeability is moderately slow, and the available water capacity is high. Organic matter content is high. Reaction is slightly acid or neutral in the subsoil. The soil puddles and clods easily. The seasonal high water table is near the surface in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for row crops and small grain. It is low for building development, sanitary facilities, and recreation uses.

If artificially drained, this soil is suited to row crops of corn and soybeans year after year. The very poor natural drainage is the main limitation in farming. Stands of wheat and oats in inadequately drained areas are poor in most years. Surface and subsurface drains are commonly needed to lower the water table, but suitable drainage outlets are difficult to establish in some areas. Tillage within a limited range of moisture content is important because the soil becomes compacted and cloddy if worked when wet and sticky. Minimum tillage and cover crops are good management practices. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact.

This soil is suited to pasture and hay, but it is poorly suited to grazing early in spring. Surface compaction, poor tilth, reduced growth, and decreased infiltration result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is suited to water-tolerant trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging can be done during the drier part of the year.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of moderately slow permeability in the subsoil, low strength, ponding, and wetness. Surface drains and storm sewers are needed. Building sites should be graded to provide good surface drainage away from the foundation. Local roads can be improved by providing artificial drainage and suitable base material.

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

Lw—Linwood muck. This nearly level, deep, very poorly drained soil is in slightly concave depressions of the uplands. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are long and narrow and 10 to 100 acres.

Typically, the surface layer is black, friable muck about 12 inches thick. Below this, to a depth of about 25 inches, is black and very dark gray, mottled, friable muck. The substratum to a depth of about 60 inches is dark gray and gray, friable fine sandy loam and silt loam. It is mottled in the upper 8 inches.

Included with this soil in mapping and making up about 10 percent of most areas are areas of very poorly drained Colwood and Millgrove soils. These soils formed in mineral materials along the edges of depressions.

Water is near the surface and ponds for long periods. Permeability is moderate, and the available water capacity is very high. Organic matter content is very high. The root zone is deep. The muck ranges from strongly acid to slightly acid. The soil has good tilth.

Most areas are used for wetland vegetation and crops. The potential is high for habitat for wetland wildlife. Drained areas have high potential for row crops and some specialty crops. The potential is low for most kinds of building site development, sanitary facilities, and recreation uses.

The very poor natural drainage and flooding limit this soil for cultivated crops. Surface and subsurface drains are needed, but suitable outlets for subsurface drains are difficult to establish in many areas. 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 amount of shrinkage. The soil is soft and highly compressible and commonly does not support narrow wheeled equipment, especially when wet. During dry periods, soil blowing and the risk of fire are major concerns. The risk of soil blowing can be reduced by irrigation, windbreaks, cover crops, and returning crop residues.

Drained areas of this soil are suited to the grasses commonly grown for hay or pasture. Water-tolerant grasses, such as reed canarygrass, grow well. Overgrazing and grazing during wet periods when the soil is soft and sticky damage plants.

This soil is not well suited to woodland because it is wet and unstable. Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. Establishing seedlings is difficult, and the larger trees are subject to windthrow. Wetness severely limits the use of logging equipment.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation by flooding, low strength, wetness, and seepage. Removing the organic deposit, adding a suitable base material, and providing drainage can improve local roads. Undrained areas provide good habitat for ducks, muskrats, and other wetland wildlife.

The capability subclass is IIw. The woodland suitability subclass is 3w.

Me—Mermill loam. This nearly level, deep, very poorly drained soil is on lake plains. In the lower parts of depressions, it is subject to ponding from runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are 10 to 100 acres. Some are more than 100 acres.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsoil is about 28 inches thick. The upper part is dark gray and grayish brown, mottled, firm clay loam and sandy clay loam; the lower part is grayish brown and dark grayish brown, mottled, friable sandy clay loam. The substratum to a depth of about 60 inches is dark brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Haskins soils on slight rises and very poorly drained Millgrove soils in the lower parts of depressions. Included soils make up about 15 percent of most areas.

Permeability is moderate in the subsoil and slow or very slow in the substratum. Organic matter content is high. The available water capacity is moderate. Runoff is very slow or ponded. The subsoil is medium acid to mildly alkaline. The seasonal high water table is perched near the surface in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till or lacustrine material.

Most areas are used for farming. The potential is high for cultivated crops, small grain, hay, pasture, and trees. It is low for most kinds of building site development, sanitary facilities, and recreation uses.

Drained areas of this soil are well suited to row crops and small grain year after year. Wetness is the main limitation in farming. It is commonly controlled by surface drains. Subsurface drains are used to lower the seasonal high water table, but suitable outlets are difficult to establish in some areas. The drains are more effective if placed on or above the slowly or very slowly permeable glacial till or lacustrine material. Minimum tillage and cover crops are good management practices, especially if this soil is row cropped year after year. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth, reduces crusting, and improves the soil-seed contact.

This soil is poorly suited to grazing early in spring. Even in drained areas, controlled grazing is a good practice. The surface layer compacts easily if pastured when soft and sticky as a result of wetness.

This soil is suited to water-tolerant trees. Small scattered areas support native hardwoods. Competing vegetation must be controlled or removed for survival and good growth of tree seedlings. Wetness limits the use of planting and harvesting equipment in winter and spring.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of wetness, slow or very slow permeability, ponding, and high shrink-swell potential in the substratum. Surface drains, subsurface drains, and storm sewers are needed. Local roads and streets can be improved by using a suitable base material. Excavations are limited in winter and spring because of wetness.

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

Mf—Millgrove loam. This nearly level, deep, very poorly drained soil is on terraces, beach ridges, and outwash plains. In the lower parts of depressions, it is subject to ponding from runoff from adjacent higher lying areas. Slope is 0 to 2 percent. Most areas are irregular in shape and 4 to 60 acres.

Typically, the surface layer is very dark grayish brown, friable loam and sandy clay loam about 11 inches thick. The subsoil is mottled, friable and firm sandy clay loam and gravelly sandy clay loam about 35 inches thick. It is dark grayish brown and grayish brown in the upper 30 inches and dark yellowish brown in the lower 5 inches. The substratum to a depth of about 60 inches is gray, mottled, friable sandy loam with thin strata of silty clay loam.

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

Permeability is moderate. Organic matter content is high. The available water capacity is moderate or high. Runoff is very slow or ponded. The subsoil is neutral or mildly alkaline. The seasonal high water table is near the surface in fall, winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is low for most kinds of building site development, sanitary facilities, and recreation uses.

This soil is suited to row crops of corn and soybeans year after year and to small grain and special crops. Wetness is the main limitation in farming. Surface drains are commonly needed. Subsurface drains are used to lower the seasonal high water table. Minimum tillage and cover crops are good management practices, especially if the soil is cropped year after year. Incorporating crop residue or other organic matter into the surface layer increases infiltration, improves tilth, reduces crusting, and improves the soil-seed contact.

Even in drained areas, controlled grazing is a good practice. The surface layer compacts easily if pastured when soft and sticky as a result of wetness. Pasture rotation and restricted grazing during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to water-tolerant trees and shrubs. A few small areas are in native hardwoods. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Wetness limits planting and harvesting equipment in winter and spring.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of wetness, ponding, and seepage. Surface drains, subsurface drains, and storm sewers are needed. Local roads and streets can be improved by providing suitable base material. Excavations are limited in winter and spring because of the high water table and sloughing of banks. As a result of seepage from such sanitary facilities as sewage lagoons and sanitary landfills, underground water supplies can be polluted.

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

Mm—Millsdale silty clay loam. This nearly level, moderately deep, very poorly drained soil is in depressions and along drainageways of the uplands and lake plains. It receives runoff from adjacent higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are irregular in shape and 4 acres to less than 100 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part is dark gray and gray, mottled, firm silty clay loam and clay loam, and the lower part is gray, grayish brown, and dark yellowish brown, mottled, firm clay loam and silty clay loam. Limestone bedrock is at a depth of about 35 inches.

Included with this soil in mapping are small areas of deep, very poorly drained Hoytville and Lenawee soils. Also included are small areas of somewhat poorly drained Randolph soils on slight rises. Included soils make up about 15 percent of most areas.

Permeability is moderately slow, and the available water capacity is low. Organic matter content is high. Runoff is slow or ponded. Reaction is neutral or slightly acid in the upper part of the subsoil and neutral or mildly alkaline in the lower part. Tilth is fair. The root zone is moderately deep. The seasonal high water table is near the surface in winter, spring, and other extended wet periods.

Most areas are farmed. The potential is fair for cultivated crops and small grain and high for hay and pasture. It is low for building site development, sanitary facilities, and recreation.

Wetness is the main limitation in farming. Drained areas are suited to corn, soybeans, wheat, oats, hay, and pasture. Surface drains are commonly needed. Subsurface drains are also used, but bedrock interferes with installation. Tillage within a limited range of moisture content is important because the soil becomes compact and cloddy if worked when wet and sticky. Minimizing tillage, planting cover crops, and incorporating crop residue or other organic matter into the surface layer help to maintain tilth, increase the rate of water infiltration, and improve fertility.

The soil is suited to pasture or hay, but it is poorly suited to grazing early in spring. Surface compaction, poor tilth, decreased infiltration, and reduced plant growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Hay and pasture plants tolerant of wetness are best suited.

The soil is suited to water-tolerant trees and shrubs. A few small areas support native hardwoods. Wetness limits planting and harvesting. Logging can be done during the drier part of the year. Seedlings grow well if competing vegetation is controlled or removed by good site preparation, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses by the moderately slow permeability, moderate depth to bedrock, wetness, ponding, and high shrink-swell potential. Areas used for these purposes should be artificially drained. Building sites should be graded to provide good surface drainage away from the foundation. Local roads can be improved by artificial drainage and using suitable base material.

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

MnA—Milton silt loam, 0 to 2 percent slopes. This nearly level, moderately deep, well drained soil is on broad, bedrock controlled landscapes of the uplands. Most areas are 10 to about 90 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm silty clay loam and silty clay about 8 inches thick. Limestone bedrock is at a depth of about 21 inches. In some areas the surface layer is loam.

Included with this soil in mapping are small areas of shallow, well drained Channahon soils near slope breaks and deep, moderately well drained Glynwood soils on broad ridgetops. Also included are small areas of somewhat poorly drained Randolph soils in shallow depressions and along drainageways and areas of soils underlain with fractured rippable bedrock. Included soils make up about 15 percent of most areas.

Permeability is moderate or moderately slow, and the available water capacity is low. Organic matter content is moderate. Runoff is slow. The subsoil is slightly acid or neutral. The root zone is moderately deep over limestone bedrock.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is medium for most kinds of building site development and low for sanitary facilities. It is high for most kinds of recreation.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The low available water capacity is the main limitation to crops. The surface layer can be worked throughout a fairly wide range of moisture content. It crusts and puddles after heavy rains. Incorporating crop residue or other organic matter into the surface layer increases the water holding capacity and the rate of water infiltration, reduces crusting, and improves the soil-seed contact. The soil is well suited to minimum tillage and irrigation.

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

The moderate depth to bedrock, moderate shrink-swell potential, and moderate or moderately slow permeability are limitations for building sites and sanitary facilities. The effluent from sanitary facilities can move through fissures in the limestone and pollute underground water supplies. Central sewage systems should be used, although the bedrock makes installation difficult. The soil is better suited to houses without basements than to houses with basements because blasting of bedrock is generally needed before a basement can be constructed. Replacing the surface layer and subsoil with a suitable base material improves local roads.

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

MnB—Milton silt loam, 2 to 6 percent slopes. This gently sloping, moderately deep, well drained soil is on broad, bedrock controlled uplands and lake plains. Most areas are 10 to more than 100 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm silty clay loam and silty clay about 11 inches thick. Limestone bedrock is at a depth of about 21 inches.

Included with this soil in mapping are small areas of shallow Channahon soils on the upper part of slopes and deep moderately well drained Glynwood soils on broad ridgetops and foot slopes. Also included are small areas of somewhat poorly drained Randolph soils in shallow depressions and along drainageways. Included soils make up about 15 percent of most areas.

Permeability is moderate or moderately slow, and the available water capacity is low. Organic matter content is moderate. Runoff from cultivated areas is medium. The subsoil is slightly acid or neutral. The root zone is moderately deep over limestone bedrock.

Most areas are farmed. The potential is high for cultivated crops, small grain, hay, pasture, and trees. It is medium for most kinds of building site development and low for sanitary facilities. It is high for most kinds of recreation uses.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The erosion hazard and low available water capacity are the main limitations to crops. The surface layer can be worked throughout a fairly wide range of moisture content. It crusts and puddles after hard rains. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the water holding capacity and the rate of water infiltration, reduces crusting, and improves the soil-seed contact.

Using this soil for pasture or hay effectively controls erosion. Surface compaction, reduced growth, poor tilth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. A few small areas are in native hardwoods. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

The moderate depth to bedrock, moderate shrink-swell potential, and moderate or moderately slow permeability are limitations for building sites and sanitary facilities. The effluent from sanitary facilities can move through fissures in the limestone and pollute underground water supplies. Central sewage systems should be used, although the bedrock makes installation difficult. The soil is better suited to houses without basements than to houses with basements because blasting of bedrock is generally needed before a basement can be constructed. Replacing the surface layer and subsoil with a suitable base material improves local roads.

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

MoA—Milton Variant loam, 0 to 2 percent slopes. This nearly level, moderately deep, well drained soil is on stream terraces. Most areas are 15 to 60 acres.

Typically, the surface layer is dark brown, friable loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is dark yellowish brown, friable clay loam and sandy clay loam, and the lower part is dark brown and dark yellowish brown, friable gravelly clay loam. Limestone bedrock is at a depth of about 38 inches.

Included with this soil in mapping are small areas of deep Gallman soils on the broader terraces and small areas of very poorly drained Millsdale and Colwood soils in depressions. Included soils make up about 15 percent of most areas.

Permeability is moderate, and the available water capacity is low. Organic matter content is moderate. Runoff is slow. Reaction ranges from medium acid to neutral in the upper part of the subsoil and from medium acid to mildly alkaline in the lower part. The root zone is moderately deep over limestone bedrock.

Most areas are farmed. The potential is high for most row crops, small grain, hay, pasture, and trees. It is medium for most building site development and low for sanitary facilities. It is high for most kinds of recreation.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The low available water capacity is the main limitation to crops. The surface layer can be worked throughout a fairly wide range of moisture content. Incorporating crop residue or other organic matter into the surface layer increases the water holding capacity and water infiltration, reduces crusting, and improves the soil-seed contact. The soil is well suited to minimum tillage and irrigation.

This soil is well suited to grazing early in spring. Surface compaction, reduced growth, and poor tilth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control, help to keep the pasture and soil in good condition.

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

The moderate depth to bedrock is a limitation for building sites and sanitary facilities. The effluent from sanitary facilities can move through fissures in the limestone and pollute underground water supplies. The soil is better suited to houses without basements than to houses with basements because blasting of bedrock is generally needed before a basement can be constructed. Replacing the surface layer and subsoil with suitable base material improves local roads.

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

MoB—Milton Variant loam, 2 to 6 percent slopes. This gently sloping, moderately deep, well drained soil is on stream terraces. Most areas are 20 to 80 acres.

Typically, the surface layer is dark brown, friable loam about 6 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable clay loam and sandy clay loam, and the lower part is dark brown and dark yellowish brown, friable sandy clay loam and gravelly clay loam. Limestone bedrock is at a depth of about 33 inches.

Included with this soil in mapping are small areas of deep Gallman soils on foot slopes and small areas of very poorly drained Millsdale soils in depressions. Included soils make up about 15 percent of most areas.

Permeability is moderate, and the available water capacity is low. Organic matter content is moderate. Runoff from cultivated areas is medium. Reaction ranges from medium acid to neutral in the upper part of the subsoil and from medium acid to mildly alkaline in the lower part. The root zone is moderately deep over limestone bedrock.

Most areas are farmed. The potential is high for most row crops, small grain, hay, pasture, and trees. It is medium for most kinds of building site development and low for sanitary facilities. It is high for most kinds of recreation uses.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The erosion hazard and low available water capacity are the main limitations to crops. The surface layer can be worked throughout a fairly wide range of moisture content. Cover crops and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the water holding capacity and the rate of water infiltration, reduces crusting, and improves the soil-seed contact. The soil is well suited to minimum tillage.

Using this soil for pasture or hay effectively controls erosion. Surface compaction, reduced growth, poor tilth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and soil in good condition.

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

The moderate depth to bedrock is a limitation for building sites and sanitary facilities. The effluent from sanitary facilities can move through fissures in the limestone and pollute underground water supplies. The soil is better suited to houses without basements than to houses with basements because blasting of bedrock is generally needed before a basement can be constructed. Replacing the surface layer and subsoil with a suitable base material improves local roads.

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

MrD2—Morley silt loam, 12 to 18 percent slopes, eroded. This moderately steep, deep, well drained soil is on hillsides. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material into the present surface layer. Most areas are long and narrow and 2 to 20 acres.

Typically, the surface layer is brown, firm silt loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is brown, firm silty clay loam and clay loam, and the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is dark yellowish brown and brown, mottled, firm clay loam and silty clay loam.

Included with this soil in mapping are small areas of moderately well drained Glynwood soils in less sloping areas and in seeps.

Permeability is moderately slow or slow. The available water capacity is moderate, although it has been significantly reduced by the effects of erosion. Organic matter content is moderately low. Runoff from cultivated areas is very rapid. Reaction ranges from medium acid in the upper part of the subsoil to neutral in the lower part. The root zone is mainly moderately deep over compact, calcareous glacial till.

Most areas are used for pasture or woodland. A few areas are being cropped. The potential is low for cultivated crops, building site development, sanitary facilities, and many kinds of recreation uses. It is high for woodland and habitat for woodland wildlife and medium for pasture.

This soil is limited for row crops because of the slope and hazard of further erosion. Row crops can be grown occasionally if erosion is controlled and the soil is otherwise well managed. The slope causes some problems in the use of machinery and the installation of erosion control measures. After the soil is plowed when wet, it is cloddy. It puddles and crusts easily. Minimum tillage, cover crops, and grassed waterways help to reduce runoff and soil loss. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth and fertility, reduces crusting, and improves the soil-seed contact.

Using this soil for pasture or hay effectively controls erosion. Surface compaction, poor tilth, reduced growth, and increased runoff result from overgrazing or grazing when the soil is too wet. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and application of the proper kind and amount of fertilizer keep the pasture and soil in good condition. Reseeding with cover crops or companion crops or trash-mulch or no-till seeding methods reduces the risk of further erosion.

This soil is well suited to trees and shrubs. Many areas are in native hardwoods. The slope moderately limits the use of equipment. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected against erosion and established across the slope if possible.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of slope and slow or moderately slow permeability. Cover should be maintained as much as possible during construction to reduce the hazard of further erosion. If proper design and installation procedures are used, the limitation imposed by slope can be partly overcome. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

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

MrF2—Morley silt loam, 18 to 50 percent slopes, eroded. This steep and very steep, deep, well drained soil is on side slopes along deep, well defined, dissected drainageways in the uplands. Erosion has removed part of the original surface layer on more than one-half of the areas. Most areas are 2 to 40 acres.

Typically, the surface layer is brown, firm silt loam about 4 inches thick. The subsoil is brown and dark yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is dark yellowish brown and brown, firm clay loam and silty clay loam.

Included with this soil in mapping are narrow bands of less sloping Glynwood soils. Also included are narrow strips of Gallman soils near the base of slopes and some short, nearly vertical escarpments along streams. Included soils make up about 15 percent of most areas.

Permeability is moderately slow or slow. The available water capacity is moderate, although it has been significantly reduced by the effects of erosion. Organic matter content is moderately low. Runoff from cultivated areas is very rapid. The subsoil ranges from medium acid to neutral. The root zone is mainly moderately deep over compact, calcareous glacial till.

Most areas are wooded. A few areas are in permanent pasture. The potential is low for cultivated crops, building site development, and sanitary facilities. It is high for woodland and habitat for woodland wildlife.

The slope severely limits the use of this soil for cultivated crops and hay. Some areas where slope is 18 to 25 percent are suited to adapted grasses and legumes for pasture. Further erosion is a severe hazard if adequate vegetative cover is not maintained. Surface compaction, poor tilth, reduced growth, and increased runoff result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, pasture rotation, and timely deferment of grazing are good management practices. No-till reseeding of pastures reduces erosion.

This soil is well suited to trees and shrubs. Most areas are in native hardwood. The slope severely limits the use of planting and logging equipment. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, or girdling. Logging roads and skid trails should be protected against erosion and should be built on the contour if possible.

The slope and slow or moderately slow permeability are severe limitations for building site development, sanitary facilities, and most kinds of recreation uses. Cover should be maintained on the site as much as possible during construction to reduce the hazard of further erosion. Trails in recreation areas should be protected against erosion and laid out across the slope if possible.

The capability subclass is VIIe. The woodland suitability subclass is 2r.

NpA—Nappanee silt loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on lake plains. Most areas are irregular in shape and 2 to 150 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is brown and grayish brown, mottled, firm silty clay about 19 inches thick. The substratum to a depth of about 60 inches is grayish brown and yellowish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of very poorly drained Hoytville soils in depressions. Also included are small areas of somewhat poorly drained Randolph soils in which limestone bedrock is at a depth of 20 to 40 inches and somewhat poorly drained Haskins soils near beach ridges. Included soils make up about 15 percent of most areas.

Permeability is very slow, and the available water capacity is moderate. Organic matter content is moderate. Runoff is slow. Reaction is neutral in the upper part of the subsoil and neutral or mildly alkaline in the lower part. The soil crusts and puddles after heavy rains. The seasonal high water table is perched at a depth of 12 to 24 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till.

Most areas are farmed. The potential is medium for row crops and small grain. It is low for most kinds of building site development and sanitary facilities. It is medium or low for most kinds of recreation uses.

Drained areas of this soil are suited to corn and soybeans. Seasonal wetness is the main limitation in farming. It delays planting and limits the choice of crops. Surface drains are commonly needed. Subsurface drains are used to lower the seasonal high water table, but movement of water into subsurface drains is slow. Minimizing tillage and incorporating crop residue or other organic material into the surface layer improve tilth and fertility, reduce crusting, and increase infiltration. The soil can be worked within only a narrow range in moisture content. Surface compaction occurs if the soil is tilled or crops are harvested during wet periods when the soil is soft and sticky.

This soil is suited to pasture and hay, but it is poorly suited to grazing early in spring. Surface compaction, poor tilth, decreased infiltration, and reduced growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Species tolerant of wetness should be selected for planting. Proper stocking, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and soil in good condition.

This soil is suited to trees and shrubs tolerant of a clayey subsoil and some wetness. A few areas are producing native hardwoods. Seedlings and cuttings of adapted species survive and grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. The use of harvesting equipment is limited during wet periods.

This soil is severely limited for building site development and sanitary facilities, and it is moderately to severely limited for most kinds of recreation uses by the very slow permeability, low strength, high shrink-swell potential, and seasonal high water table. These limitations can be partly or fully overcome by specially designed facilities. Ditches and subsurface drains are needed to improve drainage. Building sites should be graded to provide good surface drainage away from the foundation. Foundations should be designed to prevent structural damage caused by shrinking and swelling. Local roads can be improved by artificial drainage and using suitable base material.

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

NpB—Nappanee silt loam, 2 to 6 percent slopes. This gently sloping, deep, somewhat poorly drained soil is in long and narrow areas of the lake plains. Most areas are 2 to 20 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is grayish brown, mottled, firm silty clay about 18 inches thick. The substratum to a depth of about 60 inches is grayish brown and yellowish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Haskins soils near beach ridges and very poorly drained Hoytville soils in depressions and lower lying areas. Also included are small areas of somewhat poorly drained Randolph soils in which limestone bedrock is at a depth of 20 to 40 inches. Included soils make up about 15 percent of most areas.

Permeability is very slow, and the available water capacity is moderate. Organic matter content is moderate.

Runoff is medium. Reaction is neutral in the upper part of the subsoil and neutral or mildly alkaline in the lower part. The soil crusts and puddles after heavy rains. The seasonal high water table is perched near the surface in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till.

Most areas are farmed. The potential is medium for most row crops and small grains. It is low for most kinds of building site development and sanitary facilities. It is medium or low for many kinds of recreation uses.

Drained areas of this soil are suited to corn and soybeans. Erosion, wetness, and surface crusting are the main management concerns. Undrained areas warm and dry slowly in spring. Surface and subsurface drains are commonly needed. Movement of water into subsurface drains is slow. The soil can be worked within only a narrow range of moisture content. Soil compaction occurs if the soil is tilled or crops are harvested during wet periods when the soil is soft and sticky. Minimum tillage and deep rooted cover crops help to improve natural drainage. Incorporating crop residue or other organic material into the surface layer helps to improve tilth and fertility, reduce crusting, and increase infiltration. Leaving crop residue on the surface in fall and not plowing until spring also help to protect the soil against erosion.

This soil is suited to pasture or hay, but it is poorly suited to grazing early in spring. Surface compaction, reduced growth, poor tilth, and decreased infiltration rates result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Species tolerant of wetness should be selected for planting. Proper stocking, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees and shrubs that are tolerant of a clayey subsoil and some wetness. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. The use of harvesting equipment is limited during wet seasons.

Very slow permeability, low strength, high shrink-swell potential, and seasonal wetness are severe limitations for building sites and sanitary facilities. These limitations can be partly or fully overcome by specially designed facilities. Ditches and subsurface drains are needed to improve drainage. Because increased runoff and erosion occur during construction, cover should be maintained on the site as much as possible. Building sites should be graded to provide good surface drainage away from the foundation. Foundations should be designed to prevent structural damage caused by shrinking and swelling. Artificial drainage and suitable base material can improve local roads.

The capability subclass is IIIe. The woodland suitability subclass is 3c.

OpB—Oshtemo sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on knolls and short, uneven side slopes on outwash plains and end moraines. Most areas are irregular in shape and range from 20 to 40 acres.

Typically, the surface layer is dark grayish brown, friable sandy loam about 9 inches thick. The subsoil is about 36 inches thick. The upper part is brown and reddish brown, friable sandy loam, and the lower part is dark brown and reddish brown, loose loamy sand and friable gravelly sandy clay loam. The substratum to a depth of about 60 inches is brown, loose gravelly sand.

Included with this soil in mapping are small areas of moderately well drained Seward soils and well drained Spinks and Gallman soils on the same position on the landscape as this Oshtemo soil and moderately well drained Haney soils and somewhat poorly drained Haskins soils in slight depressions. Included soils make up about 15 percent of most areas.

Permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is low. Organic matter content is moderately low. Runoff is medium. The subsoil is commonly strongly acid to slightly acid. The root zone is deep. The surface layer is easily tilled throughout a fairly wide range in moisture content.

Most areas are farmed. The potential is medium for corn, soybeans, and small grain. It is high for trees, building site development, and recreation.

This soil is well suited to small grain and hay. If irrigated, it is suited to cultivated and specialty crops. Droughtiness and controlling erosion are the main management concerns. Because of the limited available water capacity, the soil is better suited to early maturing crops than to crops maturing late in summer. It is well suited to irrigation. Minimum tillage, cover crops, and grassed waterways help to prevent excessive soil loss. Returning crop residue or adding other organic material regularly helps to maintain the organic matter content, reduce crusting, and increase water intake. Because nutrients are leached at a moderately rapid rate, small but more frequent or timely applications of fertilizer and lime are more suitable than one large application.

This soil is well suited to grazing early in spring. Pasture grows slowly in summer because the soil is droughty.

This soil is suited to trees and shrubs. A few areas support native hardwoods. Seedlings are difficult to establish during dry periods in summer. Competing vegetation can be controlled or removed by cutting, spraying, girdling, or mowing.

This soil is suited as a site for buildings and recreation uses, but it is poorly suited to such sanitary facilities as sewage lagoons and sanitary landfills because of the possible contamination of ground water from seepage. Lawns are droughty during extended dry periods. If they are seeded during the drier part of the year, they should be mulched and watered. Sloughing is a hazard in excavations.

The capability subclass is IIs. The woodland suitability subclass is 3o.

Pa—Pandora silt loam. This nearly level, deep, poorly drained soil is in depressions and along drainageways of the uplands. It receives runoff from adjacent, higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are irregular in shape and 4 acres to several hundred acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 48 inches thick. The upper and middle parts are dark gray and gray, mottled, firm silty clay loam, and the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is dark brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Blount and Tiro soils on low knolls and very poorly drained Pewamo and Lenawee soils in low lying positions. Included soils make up about 15 percent of most areas.

Permeability is slow, and the available water capacity is moderate. Organic matter content is moderate. Runoff is very slow or ponded. Reaction ranges from slightly acid or neutral in the upper part of the subsoil to neutral or mildly alkaline in the lower part. The soil crusts easily after heavy rains. The seasonal high water table is near the surface in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is high for row crops, hay, pasture, and woodland. It is low for building site development, sanitary facilities, and recreation.

Wetness is the main limitation in farming. Drained areas are well suited to corn, soybeans, and small grain. Surface and subsurface drains are commonly needed. Tillage within a limited range of moisture content is important because the soil becomes compacted and cloddy if tilled during wet periods when it is soft and sticky. Minimizing tillage, planting cover crops, and incorporating crop residue or other organic matter into the surface layer help to maintain tilth, increase the rate of water infiltration, and improve the soil-seed contact.

The soil is suited to grasses and legumes for pasture or hay. Surface compaction, poor tilth, decreased infiltration, and reduced plant growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

The soil is well suited to water-tolerant trees and shrubs. A few small areas are in native hardwoods. Wetness is the main limitation in growing and harvesting trees. The use of tree planting and harvesting equipment is limited by wetness in winter and spring. Seedlings make good growth if competing vegetation is controlled or removed by good site preparation, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses by the slow permeability, wetness, ponding, and low strength. Areas used for these purposes must be artificially drained. Building sites should be graded to provide for good surface drainage away from the foundation. Local roads can be improved by artificial drainage and using suitable base material.

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

Pm—Pewamo silty clay loam. This deep, nearly level, very poorly drained soil is in shallow depressions and drainageways of the uplands. It is subject to ponding in the lower parts of depressions from runoff from adjacent higher lying soils. Most areas are irregular in shape and range from 5 to 20 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, friable and firm silty clay loam about 9 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay loam about 4 inches thick. The subsoil is about 47 inches thick. The upper and middle parts are gray, mottled, firm silty clay loam, and the lower part is yellowish brown and dark brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of very poorly drained Bono and Lenawee soils and poorly drained Pandora soils in shallow depressions and somewhat poorly drained Blount soils on slight convex rises. Included soils make up about 15 percent of most areas.

Permeability is moderately slow. Runoff is very slow or ponded. The depth of rooting is influenced by the water table. In drained areas the root zone is deep and the available water capacity is high. Organic matter content is high. The subsoil is slightly acid to mildly alkaline. The seasonal high water table is near the surface in winter, spring, and other extended wet periods. The soil puddles and clods easily.

Most areas are farmed. The potential is high for cultivated crops, small grains, hay, and pasture. It is low for most kinds of building site development, sanitary facilities, and recreation uses.

Seasonal wetness is the main limitation in farming. Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. Stands of wheat and oats, even in adequately drained areas, are poor in most years. Surface and subsurface drains are commonly needed to lower the water table. Tillage within a limited range of moisture content is important because the soil becomes compacted and cloddy if worked when wet and sticky. Returning crop residue or adding other organic material regularly improves fertility, reduces clodding, and increases the infiltration rate.

Overgrazing or grazing this soil when it is soft and sticky due to wetness are the principal concerns in pasture management. The surface layer compacts easily if pastured when wet. Proper stocking, pasture rotation, and deferment of grazing during wet periods help to keep the pasture and soil in good condition.

Small, scattered areas of this soil support native hardwoods. Water-tolerant trees should be planted. Competing vegetation can be reduced by spraying, mowing, and disking. Wetness limits the use of tree planting and harvesting equipment during winter and spring.

This soil is severely limited as a site for buildings and sanitary facilities because of seasonal wetness, ponding, moderately slow permeability, and low strength (fig. 5). Surface drains and storm sewers are needed. Local roads can be improved by artificial drainage and using suitable base material.

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

Pt—Pits, quarry. This map unit consists of areas from which limestone bedrock has been surface mined for use in construction or farming. It commonly is on uplands, typically adjacent to areas of Channahon, Millsdale, Milton, Milton Variant, and Randolph soils. Most quarries range from 50 to 400 acres. Actively mined quarries are continually enlarged. Most have a high wall on one or more sides.

Before the limestone is quarried, the overburden is generally scalped and stockpiled. This material commonly is calcareous and has poor physical properties. Content of organic matter is very low. The available water capacity varies.

Areas that are no longer mined should be reclaimed and seeded to reduce the risk of erosion. Grasses and trees that can withstand a fairly low available water capacity and unfavorable soil properties are needed for seeding and planting.

Some areas can be developed for recreation and wildlife habitat.

Pits, quarry is not assigned to a capability subclass or woodland suitability subclass.

RbA—Randolph silt loam, 0 to 2 percent slopes. This nearly level, moderately deep, somewhat poorly drained soil is on uplands. Areas range from 10 acres to several hundred acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is yellowish brown, mottled, friable and firm silty clay loam, and the lower part is dark grayish brown, mottled, firm silty clay loam. Limestone bedrock is at a depth of about 33 inches.

Included with this soil in mapping are small areas of very poorly drained Millsdale soils in depressions and well drained Milton soils on low knolls. Also included are

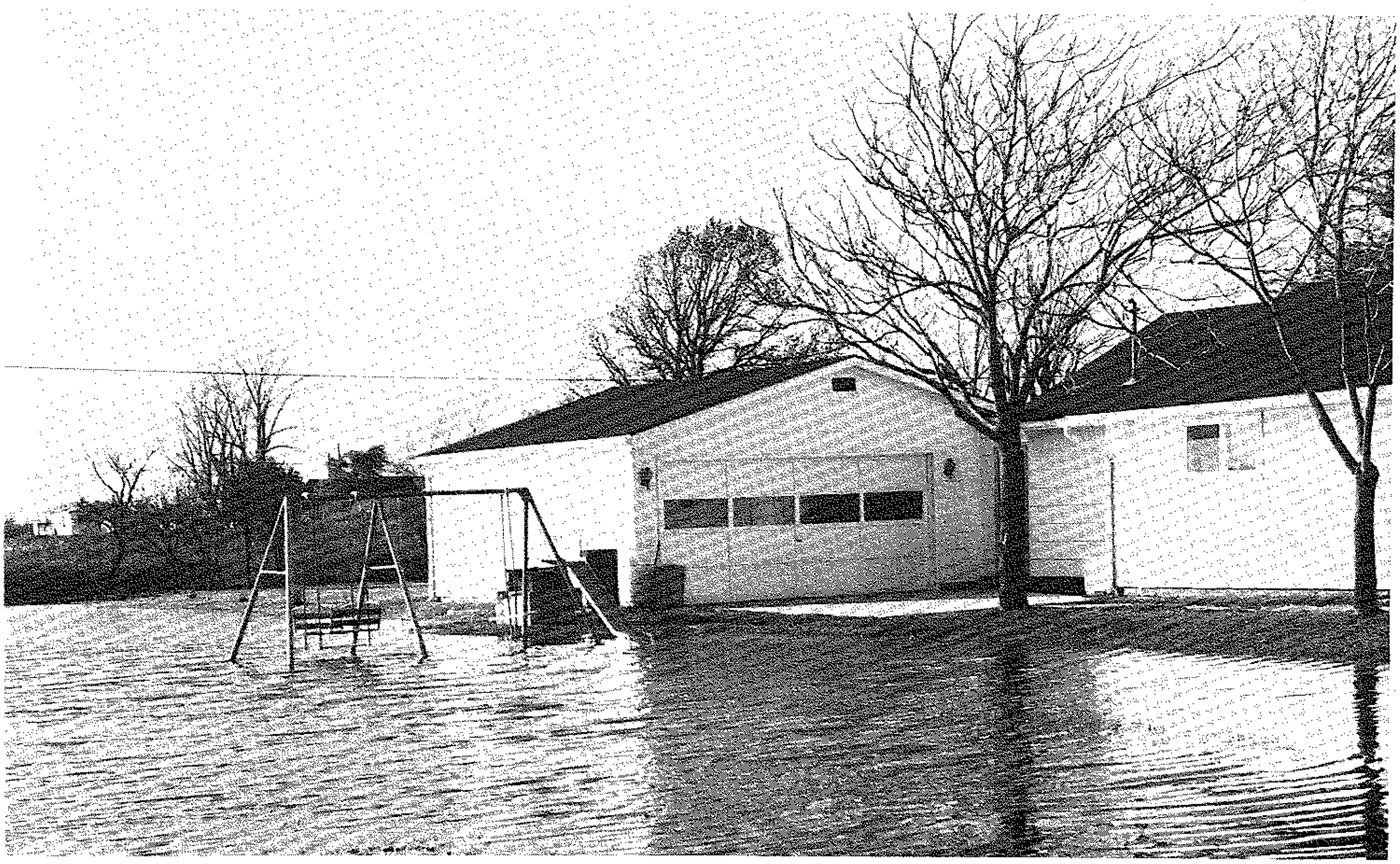

Figure 5.—Ponding on Pewamo silty clay loam.

areas of deep, somewhat poorly drained Blount and Bennington soils on broad flats. Included soils make up about 15 percent of most areas.

Permeability is moderately slow, and the available water capacity is low. Organic matter content is moderate. Runoff is slow. The subsoil is strongly acid to slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The seasonal high water table is perched at a depth of 12 to 24 inches in winter, spring, and other extended wet periods. The root zone is moderately deep over limestone bedrock.

Most areas are farmed. The potential is medium for row crops and small grain. It is high for hay and pasture. It is low for most kinds of building site development and sanitary facilities. It is medium for most kinds of recreation uses.

This soil is suited to corn, soybeans, wheat, and oats. Seasonal wetness is the main limitation in farming. Surface drains are commonly needed. Subsurface drains are used to lower the seasonal high water table, but the underlying bedrock hinders the installation of subsurface drainage systems in most areas. As a result of the low available water capacity, crop yields are reduced in some years. Minimizing tillage and incorporating crop residue or other organic material into the surface layer improve tilth and fertility, reduce crusting, and increase infiltration.

The soil is poorly suited to grazing early in spring. Grasses and legumes selected for planting should be tolerant of some wetness. Surface compaction, poor tilth, decreased infiltration, and reduced growth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas support native hardwoods. Seedlings of adapted species survive and grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities and is moderately limited for most kinds of recreation by moderately slow permeability, low strength, moderately deep depth to bedrock, high shrink-swell potential, and seasonal high water table. Ditches and subsurface drains are needed. The soil is better suited to houses without basements than to houses with basements because of wetness and the need for blasting of bedrock in most areas before a basement can be constructed. Building sites should be graded to provide good surface drainage away from the foundation. Local roads can be improved by artificial drainage and using suitable base material. Central sewage systems should be used, although the bedrock makes installation difficult.

The capability subclass is IIIw. The woodland suitability subclass is 3o.

RmB—Rawson loam, 2 to 6 percent slopes. This gently sloping, deep, moderately well drained and well drained soil is on low knolls on beach ridges, terraces, and till plains. Most areas are long and narrow or oval.

Typically, the surface layer is dark brown, friable loam about 10 inches thick. The subsoil is about 30 inches thick. The upper and middle parts are yellowish brown and dark yellowish brown, friable clay loam, gravelly loam, and gravelly clay loam, and the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of 60 inches is dark yellowish brown, mottled, firm clay loam.

Included with this soil in mapping are narrow strips of somewhat poorly drained Haskins and Blount soils on foot slopes and in nearly level areas. Also included are a few small areas of Milton soils in which limestone bedrock is at a depth of 20 to 40 inches. Included soils make up about 15 percent of most areas.

Permeability is moderate in the subsoil and slow or very slow in the substratum. The available water capacity is moderate. Organic matter content is moderate. Runoff from cultivated areas is medium, and erosion is a hazard. The subsoil is slightly acid to very strongly acid in the upper and middle parts and slightly acid to mildly alkaline in the lower part. The seasonal high water table is perched at a depth of 30 to 48 inches in winter, spring, and other extended wet periods. The root zone is mainly moderately deep over compact glacial till.

Most areas are farmed. The potential is high for row crops, small grain, hay, pasture, and trees. It is medium for building site development, sanitary facilities, and recreation uses.

This soil is suited to corn, soybeans, small grain, hay, and pasture. It is especially well suited to crops that mature early in the season. Erosion is the main hazard. Returning crop residue, minimum tillage, contour tillage, and including meadow crops in the cropping sequence commonly help to control erosion, improve tilth, and increase water infiltration. Randomly spaced subsurface drains are needed in areas of included, wetter soils and to drain seep spots.

This soil is moderately well suited to grazing early in spring. Surface compaction, reduced growth, and poor tilth result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and soil in good condition.

The soil is well suited to trees. A few areas support native hardwoods. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

Seasonal wetness, high shrink-swell potential in the substratum, and slow or very slow permeability in the lower part of the soil severely limit this soil as a site for buildings and sanitary facilities. In places artificial drainage reduces wetness and shrinking and swelling if properly designed and installed. The soil is better suited to houses without basements than to houses with basements. Building sites should be graded to provide good surface drainage away from the foundation. Exterior basement wall coatings help to prevent wet basements. The increased runoff and erosion that occur during construction can be reduced by maintaining a plant cover wherever possible. Septic tank absorption fields can be improved by increasing the size of the field. Local roads can be improved by using suitable base material.

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

RoA—Rimer loamy sand, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on beach ridges and till plains. Most areas are long and narrow or irregular in shape. They range from 5 to 20 acres.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 9 inches thick. The subsurface layer is brown, mottled, very friable loamy sand about 5 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, mottled, friable loamy sand, the middle part is dark yellowish brown, mottled, friable sandy loam, and the lower part is brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is brown, firm silty clay loam. It is mottled in the upper part.

Included with this soil in mapping are small areas of Blount soils formed in glacial till and Haskins soils formed in glacial outwash over glacial till or lacustrine material. Also included are small areas of moderately well drained Seward soils on low knolls. Included soils make up about 15 percent of most areas.

Permeability is rapid in the upper part of the subsoil and slow or very slow in the lower part and in the substratum. The available water capacity is moderate. Organic matter content is moderate or moderately low. Runoff is slow. Reaction is neutral to strongly acid in the upper and middle parts of the subsoil and slightly acid to mildly alkaline in the lower part. The surface layer can be worked throughout a wide range of moisture content. The seasonal high water table is perched at a depth of 6 to 24 inches in winter, spring, and other extended wet periods. The root zone is moderately deep to compact glacial till or lake bed sediment.

Most areas are farmed. The potential is high for row crops, small grain, hay, and pasture. It is low for most kinds of building site development and sanitary facilities. It is medium for most kinds of recreation uses.

This soil is suited to corn, soybeans, wheat, and oats. It can be used for row crops year after year if good management is used. Wetness is the main limitation in farming. Subsurface drain systems are commonly used to lower the seasonal high water table. Subsurface drains are more effective if placed on or above the slowly or very slowly permeable glacial till or lake bed sediment in the lower part of the subsoil. The soil is droughty during extended dry periods. It is well suited to irrigation. Soil blowing is a hazard where plant cover is sparse or lacking. Incorporating crop residues, planting cover crops, and applying barnyard manure help to increase organic matter content and conserve moisture.

This soil is suited to pasture or hay. Undrained areas are poorly suited to grazing early in spring. Reduced growth and poor tilth can result from overgrazing or grazing when the soil is soft as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control help to keep the pasture and the soil in good condition.

This soil is well suited to trees that tolerate some wetness. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities and is moderately limited for most kinds of recreation uses because of slow and very slow permeability, seasonal wetness, seepage, and the high shrink-swell potential in the substratum. Drainage ditches and subsurface drains help to lower the seasonal high water table. Building sites should be graded to provide good surface drainage away from the foundation. The soil is better suited to houses without basements than to houses with basements. Lateral movement of water from sanitary facilities over the slowly or very slowly permeable material in the lower part of the subsoil and in the substratum can pollute water supplies. Sanitary facilities should be connected to central sewer and treatment facilities if possible. Local roads can be improved by artificial drainage and using suitable base material. The very friable sandy surface layer affects most kinds of recreation uses.

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

Ru—Ross silt loam, occasionally flooded. This nearly level, deep, well drained soil is on flood plains and low stream terraces. It commonly occurs on the highest part of the flood plain, and it is subject to occasional flooding. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, friable silt loam about 12 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsoil is dark brown, friable silt loam about 6 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, friable loam.

Included with this soil in mapping are small areas of somewhat poorly drained Shoals soils in narrow high water channels and depressions. Also included are somewhat poorly drained Digby soils on low stream terraces. Included soils make up about 10 percent of most areas.

Permeability is moderate, and the available water capacity is high. Organic matter content is high. Runoff is slow. The subsoil is slightly acid or neutral. This soil has good tilth and can be worked throughout a wide range of moisture content. It has a deep root zone.

Most areas are farmed. The soil has high potential for row crops, pasture, and woodland and as a source of topsoil. It has low potential for most kinds of building site development and sanitary facilities. It has medium or high potential for most kinds of recreation uses.

This soil is suited to row crops year after year and to hay and pasture. In most years, row crops can be planted and harvested during the nonflooding period. Winter grains are limited by flooding. Dikes can be used to help prevent flooding. Minimizing tillage, incorporating crop residue, and planting cover crops maintain tilth, reduce crusting, and protect the surface layer in areas subject to scouring during floods.

This soil is suited to trees and other vegetation grown as habitat for wildlife. Spraying, mowing, and disking reduce plant competition.

This soil is severely limited as a site for building and sanitary facilities by the flood hazard. It is suited to such recreation uses as picnic areas and paths and trails.

The capability subclass is IIw. The woodland suitability subclass is 1o.

Sb—Sebring silt loam. This nearly level, deep, poorly drained soil is in depressions and along drainageways of the uplands. It receives runoff from adjacent higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are 5 to 20 acres.

Typically, the surface layer is dark grayish brown, friable and firm silt loam about 14 inches thick. It is mottled in the lower part. The subsoil is about 34 inches thick. The upper part is grayish brown and gray, mottled, firm silt loam and silty clay loam. The lower part is grayish brown, mottled firm, silty clay loam. The substratum to a depth of about 60 inches is gray, mottled, friable silt loam.

Included with this soil in mapping are poorly drained Pandora soils in small depressions and in narrow strips along waterways. These soils make up about 10 percent of most areas.

Permeability is moderately slow, and the available water capacity is high. Organic matter content is moderate. Runoff is very slow or ponded. The subsoil is medium acid or slightly acid. The seasonal high water table is near the surface in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The potential is medium for row crops and high for hay, trees, and habitat for wetland wildlife. It is low for most kinds of building site development, sanitary facilities, and recreation uses.

Wetness is the main limitation in farming. Drained areas are suited to corn and soybeans. Stands of wheat and oats, even in adequately drained areas, are poor in most years. Surface drains are commonly needed. Subsurface drains are used to lower the seasonal high water table. Minimum tillage and deep-rooted crops help to improve natural drainage. Incorporating crop residue or other organic matter into the surface layer improves tilth and fertility, increases the rate of water infiltration, reduces crusting, and improves the soil-seed contact.

This soil is suited to water-tolerant grasses and legumes for pasture and hay, but it is poorly suited to grazing early in spring. Surface compaction, reduced growth, poor tilth, and decreased infiltration result from overgrazing or grazing when the soil is soft and sticky as a result of wetness. Proper stocking, plant selection, pasture rotation, timely deferment of grazing, and weed control keep the pasture and the soil in good condition.

This soil is suited to water-tolerant trees and shrubs. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Wetness limits the use of tree planting and harvesting equipment.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of moderately slow permeability, wetness, ponding, and low strength. In places artificial drains are effective. Artificial drainage and suitable base material improve local roads. Sites should be graded to provide good surface drainage away from the foundation. Sanitary facilities should be connected to central sewer and treatment facilities if possible.

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

SdA—Seward loamy fine sand, 0 to 2 percent slopes. This nearly level, deep, moderately well drained soil is on beach ridges and stream terraces. Most areas are long and narrow and 3 to 20 acres.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 12 inches thick. The subsurface layer is yellowish brown, very friable loamy fine sand about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, loose loamy fine sand, the middle part is dark brown and yellowish brown, friable fine sandy loam that is mottled in the lower 4 inches, and the lower part is dark brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is dark brown, mottled, firm silty clay loam.

Included with this soil in mapping are areas of somewhat poorly drained Rimer and Haskins soils in slight depressions and somewhat poorly drained Blount soils and moderately well drained Glynwood soils in the transition zone between this Seward soil and soils formed in glacial till. Included soils make up about 15 percent of most areas.

Permeability is rapid in the upper and middle parts of the subsoil and slow or very slow in the lower part and in the substratum. The available water capacity is low. Organic matter content is moderately low. Runoff from cultivated areas is slow. Reaction is slightly acid or neutral in the upper and middle parts of the subsoil and slightly acid to mildly alkaline in the lower part. The surface layer can be worked throughout a wide range of moisture content. The root zone is mainly moderately deep over compact glacial till. The seasonal high water table is perched at a depth of 36 to 72 inches.

Most areas are farmed. The potential is high for row crops and small grain. It is medium for most kinds of building site development and sanitary facilities and medium or high for recreation.

This soil is suited to corn, soybeans, wheat, and oats. The main concerns of management are droughtiness and soil blowing. Soil blowing is especially a hazard in areas that do not have a thick plant cover and in cultivated fields in spring. Maintaining fertility and organic matter content is difficult. The soil is suited to irrigation. Minimum tillage and cover crops are good management practices. Incorporating crop residue or other organic matter into the surface layer holds moisture and improves tilth and the soil-seed contact.

This soil is well suited to hay and pasture. Deep rooted grasses and legumes should be planted. Soil blowing is a hazard in areas that are severely overgrazed. No-till reseeding reduces soil blowing.

This soil is well suited to trees and shrubs. A few small areas support native hardwoods. Drought-tolerant species should be selected for planting because seedlings are difficult to establish during the drier part of the year. Planting should be done early in spring.

Seasonal wetness, seepage, slow or very slow permeability, and the high shrink-swell potential in the lower part of the subsoil and in the substratum are severe limitations for building sites and sanitary facilities. Artificial drainage and storm sewers reduce wetness. Building sites should be graded to provide good surface drainage away from the foundation. The soil is better suited to houses without basements than to houses with basements. Foundation drains and protective exterior wall coatings help to prevent wet basements. Lawn seeding should be done early in spring. If seeded during dry periods, lawns should be mulched and watered. Septic tank absorption fields can be improved by increasing the size of the field. Lateral movement of water from sanitary facilities over the slowly or very slowly permeable material in the lower part of the subsoil and in the substratum can pollute water supplies. The very friable sandy surface layer affects most kinds of recreation.

The capability subclass is IIs. The woodland suitability subclass is 2s.

SdB—Seward loamy fine sand, 2 to 6 percent slopes. This gently sloping, deep, moderately well drained soil is on beach ridges, end moraines, and stream terraces. Most areas are long and narrow and 3 to 30 acres.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish brown and dark brown, very friable and loose loamy fine sand, the middle part is dark brown and yellowish brown, friable, mottled fine sandy loam, and the lower part is dark brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is dark brown, mottled, firm silty clay loam.

Included with this soil in mapping are areas of somewhat poorly drained Rimer and Haskins soils in slight depressions and somewhat poorly drained Blount soils and moderately well drained Glynwood soils in the transition zone between this Seward soil and soils formed in glacial till. Included soils make up about 15 percent of most areas.

Permeability is rapid in the upper and middle parts of the subsoil and slow or very slow in the lower part and in the substratum. The available water capacity is low. Organic matter content is moderately low. Runoff from cultivated areas is slow. Reaction is slightly acid or neutral in the upper and middle parts of the subsoil and slightly acid to mildly alkaline in the lower part. The surface layer can be worked throughout a wide range of moisture content. The root zone is mainly moderately deep over compact glacial till. The seasonal high water table is perched at a depth of 36 to 72 inches.

Most areas are farmed. The potential is high for row crops, small grain, hay, and pasture. It is medium for most kinds of building site development and sanitary facilities. It is medium or high for recreation uses.

This soil is well suited to corn, soybeans, wheat, and oats. Droughtiness, soil blowing, and erosion are the main concerns of management. Soil blowing is especially a hazard in areas that do not have a thick plant cover and in cultivated fields in spring. Maintaining fertility and organic matter content is difficult. This soil is suited to irrigation. Minimum tillage, cover crops, and grassed waterways help to reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth, conserves water, and improves the soil-seed contact.

Using this soil for pasture or hay effectively controls erosion and soil blowing. Deep-rooted grasses and legumes should be planted. No-till reseeding reduces soil blowing and erosion.

This soil is well suited to trees and shrubs. Drought-tolerant species should be selected for planting because seedlings are difficult to establish during the drier part of the year. Planting should be done early in spring.

Seasonal wetness, seepage, slow or very slow permeability, and the high shrink-swell potential in the lower part of the subsoil and in the substratum limit this soil as a site for buildings and sanitary facilities. Cover should be maintained on the site as much as possible during construction to reduce soil blowing and erosion. Building sites should be graded to provide good surface drainage away from the foundation. Lawn seeding should be done early in spring. If seeded during dry periods, lawns should be mulched and watered. Septic tank absorption fields can be improved by increasing the size of the field. Lateral movement of water from sanitary facilities over the slowly or very slowly permeable material in the lower part of the subsoil and in the substratum can pollute water supplies. The very friable sandy surface layer affects most kinds of recreation uses.

The capability subclass is IIe. The woodland suitability subclass is 2s.

Sh—Shoals silt loam, frequently flooded. This nearly level, deep, somewhat poorly drained soil is in narrow strips in high water channels of wide flood plains. It commonly occupies the entire flood plain along small streams. It is frequently flooded for brief periods in fall, winter, and spring. Slope is 0 to 2 percent. Most areas range from 10 to 100 acres.

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 grayish brown, dark brown, and dark yellowish brown, mottled, friable loam and clay loam.

Included with this soil in mapping and making up about 10 percent of most areas are small areas of well drained Chagrin soils on slightly higher positions.

Permeability is moderate, and the available water capacity is high. Organic matter content is moderate. Runoff is very slow. The substratum is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. This soil has good tilth and can be worked throughout a wide range of moisture content. The seasonal high water table is at a depth of 12 to 36 inches in winter, spring, and other extended wet periods. The root zone is deep.

Most areas are farmed. The soil has high potential for row crops, pasture, and woodland and as a source of topsoil. It has low potential for most building site development, sanitary facilities, and most kinds of recreation uses.

The flooding hazard and wetness limit the use of this soil as cropland (fig. 6). They delay planting in most years and limit the choice of crops. The soil is suited to row crops that can be planted after the major threat of flooding. Flooding severely damages winter grain crops if they are not protected. Subsurface drains are commonly used but outlets are difficult to establish in some areas. Minimizing tillage, incorporating crop residue, and planting cover crops maintain tilth, reduce crusting, and protect the surface in areas subject to scouring during floods.

This soil is suited to pasture, but maintaining tilth and desirable forage stands is difficult unless the soil is drained and grazing is controlled. Overgrazing or grazing this soil when soft and sticky as a result of wetness causes compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees and other vegetation grown as habitat for wildlife. Species that tolerate some wetness should be selected for reforestation.

The flood hazard and seasonal wetness severely limit this soil as a site for buildings and sanitary facilities. The soil has potential for such recreation uses as hiking during the drier part of the year. Local roads can be improved by artificial drainage and using a suitable base material.

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

Figure 6.—Shoals silt loam, frequently flooded, is limited for cropland.

SpB—Spinks loamy sand, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on beach ridges and end moraines. Most areas are long and narrow and range from 3 to 400 acres.

Typically, the surface layer is dark brown, very friable loamy sand about 9 inches thick. The subsurface layer is pale brown and yellowish brown, friable loamy sand about 12 inches thick. The next layer is pale brown and yellowish brown, very friable loamy sand 69 inches thick. It has thin bands of dark brown sandy loam.

Included with this soil in mapping are small areas of well drained Gallman and moderately well drained Haney soils on side slopes. Also included are small areas of moderately well drained Seward soils in the transition zone between this Spinks soil and soils formed in glacial till. Included soils make up about 10 percent of most areas.

Permeability is moderately rapid or rapid, and the available water capacity is low. Organic matter content is low. Runoff is slow. The subsoil is medium acid to neutral. The root zone is deep.

Most areas are farmed. The potential is medium for farming, woodland, and recreation uses. It is high for building site development but low for most kinds of sanitary facilities.

The low available water capacity and sandy surface layer are major limitations in farming. If irrigated, the soil is suited to cultivated crops and special crops. It is especially well suited to deep-rooted crops. Crops can be planted earlier in spring on this soil than on most other soils in the county. The soil responds well to good management practices. Because applied nutrients are rapidly leached from the soil, smaller but more frequent or more timely applications of fertilizer and lime are more suitable than one application. Soil blowing and water erosion are hazards. The abrasive action of blowing sand damages plant seedlings. Using crop residues and cover crops help to maintain organic matter content, conserve moisture, and reduce erosion.

This soil is suited to drought-tolerant trees. Seedling mortality is a hazard during dry seasons because of droughtiness. Windbreak plantings help to control soil blowing.

This soil is well suited as a site for buildings. Sanitary facilities are limited by the possible contamination of ground water as a result of seepage. Sloughing is a hazard during excavations. Erosion and soil blowing are hazards. Cover should be maintained on the site as much as possible during construction to reduce erosion and soil blowing. Lawns seeded during the drier part of the growing season are commonly failures. If lawns are seeded during dry periods, they should be mulched and watered. The sandy surface layer limits most kinds of recreation uses.

The capability subclass is IIIs. The woodland suitablity subclass is 3s.

TrA—Tiro silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad flats of till plains. Most areas are irregular in shape and 20 to several hundred acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 40 inches thick. The upper part is brown and yellowish brown, mottled, friable and firm silty clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam.

Included with this soil in mapping are small areas of poorly drained Pandora soils and very poorly drained Lenawee soils in depressions and along drainageways. Also included are small areas of somewhat poorly drained Bennington soils on slight rises. Included soils make up about 10 percent of most areas.

The seasonal high water table is perched at a depth of 12 to 30 inches in winter, spring, and other extended wet periods. Permeability is moderate in the upper part of the soil and moderately slow or slow in the lower part and in the substratum. Runoff is slow. The root zone is mostly moderately deep over compact glacial till. The available water capacity is moderate. Organic matter content is moderate. Reaction is neutral to strongly acid in the upper part of the subsoil and slightly acid to mildly alkaline in the lower part.

Most of the acreage is farmed. The potential is high for cultivated crops, hay, and pasture. It is low for most kinds of building site development and sanitary facilities. It is medium for most kinds of recreation uses.

This soil is suited to corn, soybeans, small grain, pasture, and hay. Wetness is the main limitation in farming. It delays planting and limits the choice of crops. Surface drains and land smoothing are commonly needed. Subsurface drains are commonly used to lower the seasonal high water table. Compaction occurs if tillage or harvesting is done when the soil is soft and sticky as a result of wetness. These operations are best performed at optimum moisture levels with the kind of equipment that minimizes soil compaction. Minimizing tillage and incorporating crop residue or other organic matter into the surface layer improve tilth and fertility, increase the rate of water infiltration, and reduce crusting.

This soil is not well suited to grazing early in spring. Overgrazing or grazing when soft and sticky as a result of wetness causes surface compaction and poor tilth.

This soil is well suited to trees that tolerate some wetness. A few areas support native hardwoods. Seedlings of adapted species make good growth if competing vegetation is controlled or removed by such practices as cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings, sanitary facilities, and most kinds of recreation by the slow or moderately slow permeability, seasonal wetness, and low strength. Drainage ditches and subsurface drains lower the seasonal high water table. Building sites should be graded to provide good surface drainage away from the foundation. Foundation drains and protective exterior wall coatings help to keep basements dry. Local roads can be improved by artificial drainage and using suitable base material.

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

TrB—Tiro silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on low knolls and at the heads of drainageways. Most areas are irregular in shape and range from 4 acres to several hundred acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. The upper part is brown and yellowish brown, mottled, friable silty clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm clay loam. The surface layer is 4 to 6 inches thick in some areas.

Included with this soil in mapping are small areas of poorly drained Pandora soils in depressions and along drainageways. Also included are small areas of somewhat poorly drained Bennington soils on slightly convex knolls. Included soils make up about 15 percent of most areas.

The seasonal high water table is perched at a depth of 12 to 30 inches in winter, spring, and other extended wet periods. Permeability is moderate in the upper part of the soil and moderately slow or slow in the lower part and in the substratum. Runoff is medium. The root zone is mainly moderately deep over compact glacial till. The available water capacity is moderate. Organic matter content is moderate. Tilth is good. Reaction is neutral to strongly acid in the upper part of the subsoil and slightly acid to mildly alkaline in the lower part.

Most of the acreage is farmed. The potential is high for cultivated crops, hay, and pasture. It is low for most kinds of building site development and sanitary facilities. It is medium for most kinds of recreation uses.

This soil is suited to corn, soybeans, small grain, hay, and pasture. Erosion control, wetness, and surface crusting are the main management concerns. Subsurface drains are commonly used to lower the water table. Compaction occurs if tillage or harvesting is done when the soil is soft and sticky as a result of wetness. Tillage and harvesting are best performed at optimum moisture levels with the kind of equipment that minimizes soil compaction. Minimizing tillage and incorporating crop residues or other organic matter into the surface layer improve tilth and fertility, increase the rate of water infiltration, and reduce crusting. Leaving crop residue on the surface in fall and not plowing until spring also help to protect the soil against erosion.

This soil is poorly suited to grazing early in spring. Overgrazing or grazing when soft and sticky as a result of wetness are major concerns of pasture management. The silt loam surface layer compacts easily when wet, resulting in poor tilth and damage to pasture plants.

This soil is well suited to trees that tolerate some wetness. A few areas support native hardwoods. Seedlings of adapted species grow well if competing vegetation is controlled or removed by such practices as cutting, spraying, girdling, or mowing.

This soil is severely limited as a site for buildings and sanitary facilities, and it is moderately limited for most recreation uses because of slow or moderately slow permeability, seasonal wetness, and low strength. Drainage ditches and subsurface drains lower the seasonal high water table. Foundation drains and protective exterior wall coatings help to prevent wet basements. Artificial drainage and suitable base material can improve local roads. Cover should be maintained on the site as much as possible during construction to reduce runoff and erosion. Even though seepage is a limitation for ponds, most areas are well suited to ponds (fig. 7).

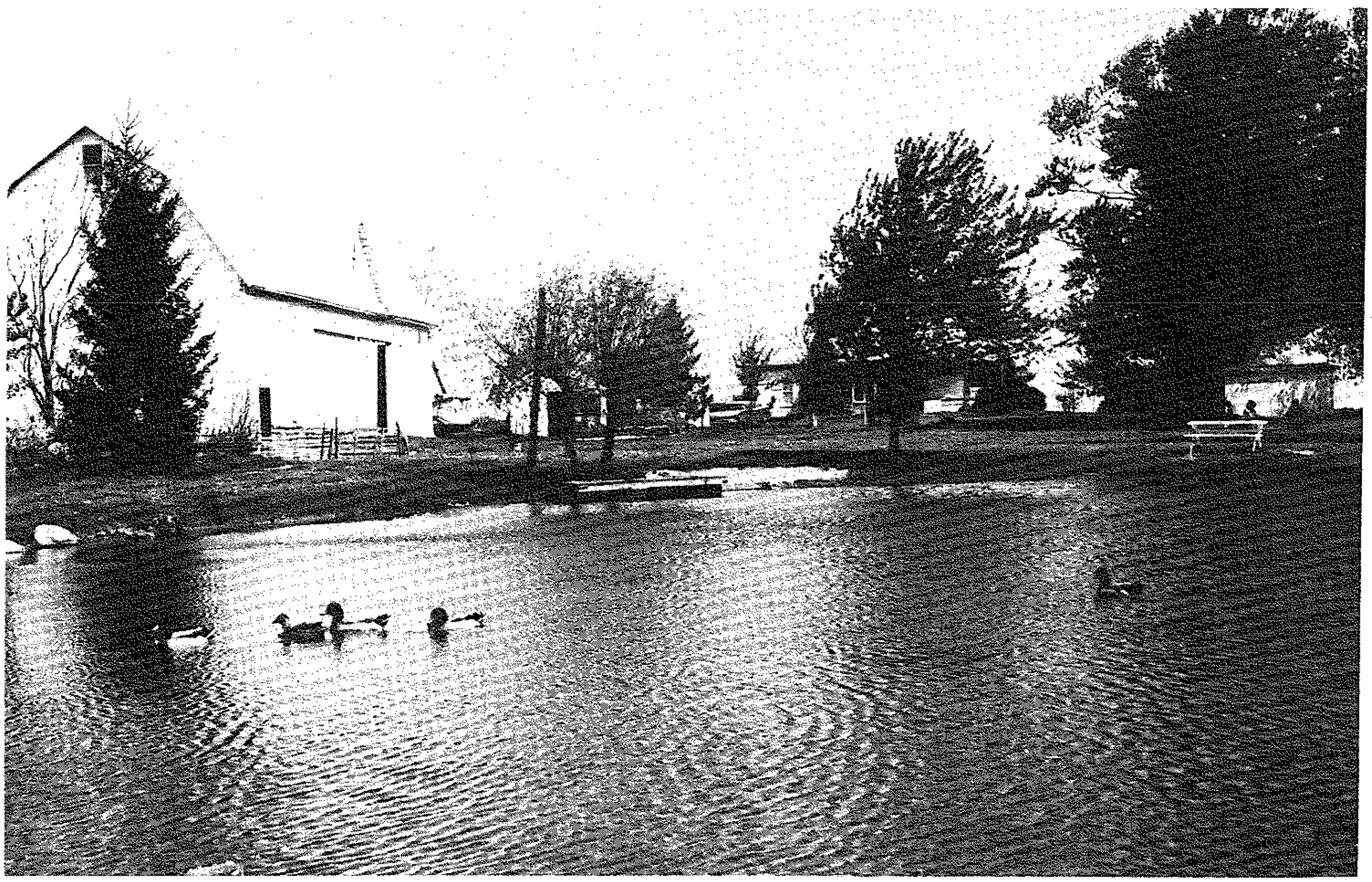

Figure 7.—Farm pond on Tiro silt loam, 2 to 6 percent slopes. It provides recreation and water for livestock and fire protection.

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

Ua—Udorthents, loamy. These soils occur as areas of cut and fill. They are mainly in areas of construction. In areas that have been cut, the remaining soil material typically is similar to the subsoil or substratum of adjacent soils. In fill or disposal areas, the characteristics of the soil material are more varied, and this soil material generally is the subsoil and substratum of nearby soils. Slope ranges from 0 to 6 percent. Most areas are 10 to 80 acres.

Typically, the upper 60 inches is clay loam, silty clay loam, or clay. The available water capacity is variable but is dominantly low or very low in the root zone. Internal water movement and runoff are variable. Tilth is poor. Hard rains tend to seal the surface in poorly vegetated areas. As a result, the infiltration rate is reduced and the emergence and growth of plants is restricted. The seasonal high water table is evident in some areas, particularly in graded areas that are depressed or bowl shaped. The root zone is medium acid to moderately alkaline.

Most areas have some type of vegetative cover, but some have no cover. These soils are poorly suited to grasses and legumes for hay and pasture. In areas where the surface is bare, the erosion hazard is severe. Suitable plant cover is needed to control erosion. The suitability of the soils as a site for buildings and sanitary facilities varies. Onsite investigation is needed to determine the potential and limitation for any proposed use.

Udorthents, loamy, are not assigned to a capability subclass or woodland suitability subclass.

Ur—Urban land. Urban land consists of areas covered with buildings and pavement or other manmade surfaces. Included are commercial and industrial areas. Construction covers a high percentage of the total area. Only a limited acreage is natural soil. As a result, runoff from these areas is increased in volume and rate. Urban land potentially can be a source of pollution to nearby streams. Onsite investigation is needed to determine the potential and limitation for any proposed use.

Urban land is not assigned to a capability subclass or woodland suitability subclass.

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

Gene F. Baltes, 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 "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 281,000 acres in the survey area was used for crops and pasture in 1967, according to the Conservation Needs Inventory (*7*). Of this total, about 150,711 acres was used for row crops, mainly corn and soybeans; 52,058 acres for close-grown crops, mainly wheat and oats; 33,563 acres for rotation hay and pasture; and 13,015 acres for permanent pasture. The rest was idle cropland and orchards, vineyards, and brush fruit.

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

Soil drainage. 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 common to the area is generally not possible unless these soils are artificially drained. Examples are the poorly drained and very poorly drained Bono, Colwood, Hoytville, Lenawee, Mermill, Millgrove, Millsdale, Pandora, Pewamo, and Sebring soils, which make up about 88,000 acres. Also in this category are the organic Carlisle and Linwood soils, which make up about 700 acres.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged in most years and planting or harvesting is delayed. Examples are Bennington, Blount, Digby, Fitchville, Haskins, Kibbie, Nappanee, Randolph, Rimer, Shoals, and Tiro soils, which make up about 201,700 acres.

Small areas of wet soils along drainageways and in swales are commonly included in areas of the moderately well drained Glynwood, Haney, Rawson, and Seward soils. Artificial drainage is needed in those areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and subsurface drainage is needed in most areas of the poorly drained and very poorly drained soils that are used for intensive row crops (fig. 8). Drains have to be more closely spaced in slowly or very slowly permeable soils than in the more permeable soils. Subsurface drainage is very slow in Bono and Nappanee soils. Finding adequate outlets for subsurface drainage systems is difficult in depressed areas of uplands and broad flat areas of lake plains.

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 oxidation and subsidence of organic soils. Information on the drainage design for each kind of soil is available in the local office of the Soil Conservation Service.

Soil erosion. Erosion is a major hazard on about one-third the cropland and pastureland in Seneca County. If the slope is more than 2 percent, erosion is a hazard (figs. 1 and 4). Bennington, Blount, Glynwoods, Haskins, Nappanee, and Tiro soils, for example, have slopes of 2 to 6 percent. In addition, they are wet.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Erosion is especially damaging on soils with a clayey subsoil, such as Nappanee soils. Erosion also reduces productivity on soils that tend to be

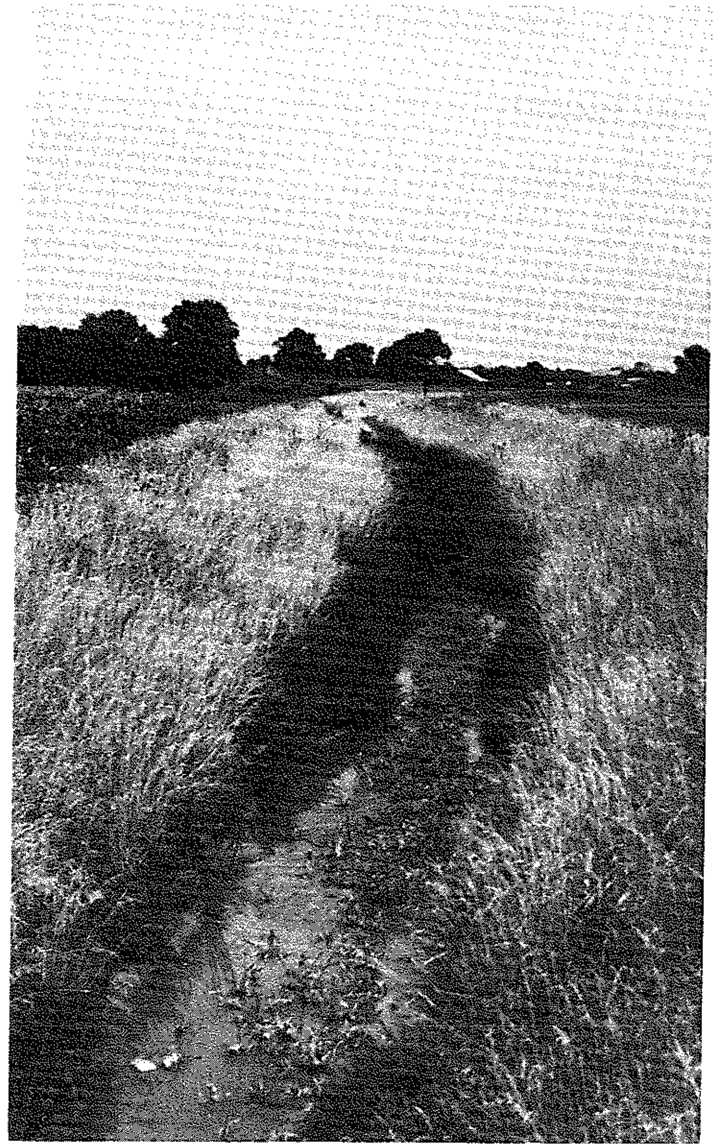

Figure 8.—Open ditches provide drainage on most of the poorly drained and very poorly drained soils. Ditchbanks are protected by tall fescue.

droughty, such as Belmore and Spinks soils. Second, erosion results in sediments entering the stream. Control of erosion minimizes the pollution of streams by sediments and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In eroded spots on many gently sloping and sloping fields, preparing a good seedbed and tilling are difficult because part of the original friable surface layer has been removed by erosion. Such spots are common in the eroded Bennington, Glynwood, and Haney soils.

Erosion control provides protective surface cover, reduces runoff, and increases infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses at an amount that will not reduce the productive capacity of the soil. On livestock farms where part of the acreage is pasture and hay, including legume and grass forage crops in the cropping system reduces the risk of erosion, provides nitrogen, and improves tilth for the following crop.

Slopes are so short and irregular that contour tillage or terracing is not practical in most areas of the gently sloping and sloping Belmore, Gallman, Glynwood, and Haney soils. On these soils, a cropping system that provides a substantial plant cover is needed to control erosion unless tillage is kept to a minimum.

Minimizing tillage and leaving crop residue on the surface increase infiltration and reduce the hazard of runoff and erosion (fig. 3). Both can be adapted to most soils in the survey area. No tillage, which is effective in reducing the erosion hazard on sloping land, can also be adapted to most soils in the survey area. It is less effective, however, on the somewhat poorly drained to poorly drained soils.

Terraces and diversions reduce the length of slope, control runoff, and reduce the risk of erosion on long slopes. They are most practical on deep, well drained soils that have smooth slopes, Belmore and Gallman soils, for example. Most soils in the county are not so well suited to terracing and diversions because of irregular slope, excessive wetness in terrace channels, and a clayey subsoil or bedrock at depths of 10 to 40 inches, which would be exposed in terrace channels.

Grassed waterways are natural or constructed outlets that are protected by grass cover. Natural drainageways make the best sites for waterways and commonly require minimum shaping (fig. 2). They should be wide and flat so that farm machinery can cross them easily.

Soil blowing is a hazard on the organic Carlisle and Linwood soils and on the sandy Spinks, Seward, and Rimer soils. Maintaining a plant cover, a surface mulch, or a rough surface through proper tillage minimizes the hazard of soil blowing. Windbreaks of suitable shrubs, such as Tatarian honeysuckle or autumn-olive, are also effective.

Contouring and contour stripcropping help in controlling erosion, but their use is limited in Seneca County because slopes are generally short and irregular. Contouring and even stripcropping are practical in some areas, for example, on Glynwood and Haney soils.

Information on the design of erosion control practices for each kind of soil is available in the local office of the Soil Conservation Service.

Soil fertility. Fertility is naturally low in many soils on the uplands. The soils on flood plains, such as Chagrin, Ross, and Shoals, are higher in plant nutrients than most upland soils. Bono, Colwood, Hoytville, Lenawee, Mermill, Millgrove, Millsdale, Pandora, Pewamo, and Sebring soils in low swales and drainageways commonly have a slightly acid or neutral surface layer.

Unless limed, Carlisle and Linwood soils are commonly strongly acid to neutral. In some areas, special fertilizer is needed because these soils are deficient in boron and other trace elements.

Many upland soils are naturally acid in the surface layer. Applications of ground limestone are needed to raise the pH level sufficiently for good growth of alfalfa and other crops that grow on nearly neutral soils. Available phosphorus and potash levels are naturally low in most of these soils.

On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer and lime to be applied.

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

Most soils used for crops in the survey area have a light colored silt loam surface layer that is moderate or moderately low in content of organic matter. Generally, the structure of such soils is weak and intense rainfall causes a crust formation on the surface. The crust is hard when dry and is nearly impervious to water. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material can improve soil structure and reduce the likelihood of crusting.

Fall plowing is generally not a good practice on soils that have a light colored surface layer because a crust forms in winter and spring. Many soils that are plowed in fall are nearly as dense and hard at planting time as they were before they were plowed. In addition, all sloping soils and some nearly level, light colored soils are subject to erosion and soil blowing after they have been plowed in fall.

The darker colored surface layer of Bono, Hoytville, Lenawee, Millsdale, and Pewamo soils contains more clay than that of the light colored soils. Poor tilth can be a problem because these soils often stay wet until late in spring. If plowed when wet, these soils tend to be cloddy when dry. As a result, 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 are many field crops that are not now commonly grown. Corn and soybeans are the main row crops. Wheat and oats are the most commonly grown close-growing crops. Grain sorghum, sunflowers, potatoes, and similar crops can be grown. Rye, barley, buckwheat, and flax should be considered. Grass seed can be produced from bromegrass, timothy, fescue, redtop, and bluegrass.

Irrigation. Generally, Seneca County receives ample rainfall for crop moisture requirements. Irrigation is not extensive. Intervals commonly occur, however, when rainfall is not timely or is not well distributed. During these periods, supplemental irrigation should be considered.

Many soils in the county are suited to irrigation and can be irrigated if water is available. Soils that have slopes of less than 6 percent are suitable for sprinkler irrigation and need only a minimum of artificial drainage. Oshtemo, Seward, Rimer, and Spinks soils are rapidly permeable and do not hold enough water for crop growth during extended dry periods. Irrigation on these soils has to be more frequent than on most other soils. Belmore, Haney, Chagrin, Gallman, and Ross soils are well suited to irrigation. Digby, Kibbie, Colwood, Millgrove, Mermill, and Shoals soils can be irrigated if adequately drained. Other soils in the county are not so well suited to irrigation because of excessive slope, slow intake rate, surface crusting, limited capacity to store available moisture, or poor natural drainage. Information on irrigation is available from the Cooperative Extension Service and the local office of the Soil Conservation Service. Use of water from streams and ponds is controlled by the Ohio Department of Natural Resources.

Specialized crops. Tomatoes and sugar beets are commonly grown in the county. A small acreage is in cabbage, potatoes, cucumbers, and sweet corn. Information on specific management, fertilization rates and seed varieties can be obtained from the local offices of the Cooperative Extension Service and Soil Conservation Service or from field representatives of commercial packing and processing companies.

Sugar beets grow well on soils that have a high available water capacity, a high content of organic matter, and pH between 6.5 and 7.0. Deep, dark colored, medium textured or moderately fine textured soils are well suited to sugar beets. Good soil tilth and aeration are important. Hoytville, Colwood, Kibbie, Millgrove, and Mermill soils are used most extensively for sugar beets, but surface crusting and restricted aeration are limitations.

Tomatoes grow best on dark colored medium textured or moderately fine textured soils that have a deep root zone, a high available water capacity, and a high content of organic matter. Hoytville, Colwood, Kibbie, Millgrove, and Mermill soils are well suited to tomatoes.

Tomatoes have deep roots and can therefore be damaged by excess water in the root zone. They are more susceptible to injury from water near maturity. Surface flooding damages tomatoes within hours. Consequently, good drainage is essential on the surface and within the root zone. Commonly used for tomatoes are dark colored very poorly drained soils that have good surface and subsurface drainage and adequate soil aeration.

Loamy and sandy soils that have good internal drainage are well suited to vegetables, such as cabbage, cucumbers, sweet corn, and potatoes. These soils warm up early in spring, have a good water intake, and can be tilled throughout a wide range of moisture content without severe compaction or damage to soil structure.

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. Only class and subclass are used in this survey. These levels are defined in the following paragraphs (*11*).

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, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

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 "Soil maps for detailed planning."

Woodland management and productivity

Nearly all of Seneca County was forested at the time of settlement. The original forest types were beech, elm-ash swamp, oak-sugar maple, and mixed oak (*6*). As a result of clearing, the acreage of woodland has been reduced to about 36,000 acres, or 12 percent of the county. The rest is chiefly small farm woodlots. The steepest, wettest, or less accessible parts of the farms have typically remained wooded. Most of the woodland has been cutover, and much of it has been grazed.

Compared with the returns from the sale of other farm products, income from the sale of wood products is small. Some good quality logs of red oak, white oak, and black walnut are still cut from the better managed woodlots. Farm woodlots are still a source of wood for fireplaces and lumber for rough construction. They are also a source of edible nuts.

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 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 normal 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. 9). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

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

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely

Figure 9.—Windbreak on Milton silt loam, 2 to 6 percent slopes, provides protection from wind and snow.

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 local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

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, 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 quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. 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 or a cemented pan, 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 (fig. 5) 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 the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 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 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, perforated plastic tubing, 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, topsoil, 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 properties and classifications 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 used in great quantities in many kinds of construction. The ratings in table 13 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 15.

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 kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds.

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 wind 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 wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

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

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

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 morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*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. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

8. Stony or gravelly soils and other soils not subject to wind erosion.

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 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 specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

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

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

These data were used in classifying and correlating these soils and in evaluating their behavior characteristics under various land uses. Six of the profiles sampled were selected as representative for the respective series and are described in this survey. The series and laboratory identification numbers are Bono (SA-27), Gallman (SA-25), Glynwood (SA-30), Oshtemo (SA-17), Pandora (SA-33), and Rawson (SA-29).

In addition to the Seneca County data, laboratory data for many of the same soils are also available from nearby counties in northwestern Ohio. These data and the Seneca County 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 through special studies of soils in nearby counties (*9, 14*).

Engineering test data

Table 18 shows laboratory test data for three pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and morphology." The soil samples were tested by the State of Ohio, Department of Transportation Division of Highways, Testing Laboratory.

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

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); 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 (*12*). 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 dryer 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 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 (*10*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*12*). 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 "Soil maps for detailed planning."

Belmore series

The Belmore series consists of deep, well drained soils formed in loamy water sorted material. These soils are on beach ridges, stream terraces, and outwash plains. Permeability is moderately rapid. Slope ranges from 2 to 6 percent and from 18 to 50 percent.

Belmore soils are similar to Gallman, Milton variant, Oshtemo, and Spinks soils and are commonly adjacent to Digby and Haney soils. Digby and Haney soils are wetter. Digby soils have low chroma mottles just below the A horizon, and Haney soils have mottles in the lower part of the subsoil. Gallman soils have a thicker solum. Milton variant soils have limestone bedrock at a depth of 20 to 40 inches. Oshtemo soils have less clay in the argillic horizon. Spinks soils have lamellae and more sand in the solum.

Typical pedon of Belmore loam, 2 to 6 percent slopes, near Bascom in Hopewell Township, about 2,125 feet east and 1,500 feet south of the northwest corner of sec. 18, T. 2 N., R. 14 E.

Ap—0 to 6 inches; dark brown (10YR 4/3) loam; weak fine and medium granular structure; friable; many roots; 10 percent coarse fragments; neutral; abrupt smooth boundary.

B1—6 to 10 inches; dark brown (7.5YR 4/4) clay loam; moderate fine subangular blocky structure; friable; common roots; few dark brown (10YR 3/3) fillings in worm channels; 10 percent coarse fragments; neutral; clear smooth boundary.

B21t—10 to 16 inches; dark brown (7.5YR 4/4) gravelly clay loam; weak medium subangular blocky structure; friable; common roots; thin patchy dark brown (7.5YR 4/2) clay films bridging sand grains; 15 percent coarse fragments; neutral; clear smooth boundary.

B22t—16 to 24 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky stucture; friable; common roots; thin patchy clay films bridging sand grains; 5 percent coarse fragments; neutral; clear smooth boundary.

B23t—24 to 37 inches; dark brown (7.5YR 4/4) gravelly clay loam; weak medium subangular blocky structure; firm; few roots; thin patchy clay films bridging sand grains; 15 percent coarse fragments; neutral; abrupt smooth boundary.

B24t—37 to 43 inches; dark brown (7.5YR 4/4) sandy loam; massive; friable; few roots; thin patchy clay films bridging sand grains; 5 percent coarse fragments; neutral; abrupt smooth boundary.

B3—43 to 46 inches; yellowish brown (10YR 5/4) gravelly sandy loam; massive; very friable; few roots; 15 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C—46 to 60 inches; light brownish gray (10YR 6/2) stratified gravelly sandy loam with thin strata of gravelly sand; massive; single grained; very friable and loose; 35 percent gravel; strong effervescence; moderately alkaline.

Solum thickness ranges from 22 to 55 inches but is commonly 40 to 55 inches. Fine gravel content ranges from 2 to 15 percent by volume in the A horizon and from 2 to 35 percent in the B horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is clay loam, sandy loam, or loam and gravelly analogs of these textures. The upper part of the B horizon is neutral or slightly acid and the lower part is slightly acid to mildly alkaline. The C horizon has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 2 to 5. It is stratified gravelly sandy loam, gravelly loam, or gravelly sand.

Bennington series

The Bennington series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in glacial till medium in content of lime. Slope is 2 to 6 percent.

Bennington soils are commonly adjacent to Pandora, Sebring, and Tiro soils and are similar to Blount and Nappanee soils. Blount and Nappanee soils have less sandstone and shale fragments throughout, and they formed in glacial till with a higher calcium carbonate equivalent. Pandora and Sebring soils are wetter and have dominantly low chroma colors between the A horizon and a depth of 30 inches. Tiro soils formed in lacustrine or alluvial sediment over glacial till, and they have more silt and less clay in the argillic horizon.

Typical pedon of Bennington silt loam, 2 to 6 percent slopes, about 2 miles south of St. Stephens, in Bloom Township, 500 feet north and 2,500 feet west of the southeast corner of sec. 36, T. 1 N., R. 16 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B21t—9 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; friable; common roots; thin patchy grayish brown (10YR 5/2) clay films and grayish brown (10YR 5/2) coatings on faces of peds; medium acid; 1 percent coarse fragments; clear smooth boundary.

B22t—16 to 20 inches; yellowish brown (10YR 5/6) silty clay loam; few fine distinct strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; thin patchy light brownish gray (10YR 6/2) clay films and grayish brown (10YR 5/2) coatings on faces of peds; 2 to 5 percent coarse fragments; medium acid; clear smooth boundary.

B31t—20 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2); and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy grayish brown (10YR 5/2) clay films and dark grayish brown (10YR 4/2) coatings on faces of peds; 5 to 10 percent coarse fragments; slightly acid; clear smooth boundary.

B32—27 to 34 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium platy structure; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; neutral; clear wavy boundary.

C1—34 to 44 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium platy structure; firm; dark grayish brown (10YR 4/2) coatings on faces of peds; light gray (10YR 7/2) calcium carbonate accumulations; 5 to 10 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—44 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; 5 to 10 percent coarse fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 28 to 40 inches. Depth to carbonates ranges from 26 to 46 inches.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 2. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam or clay loam. It is medium acid or strongly acid in the upper part and slightly acid or neutral in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is loam, clay loam, or silty clay loam.

Blount series

The Blount series consists of deep, somewhat poorly drained, slowly permeable or moderately slowly permeable soils. These soils formed on till plains in calcareous glacial till high in content of lime. Slope is 0 to 6 percent.

Blount soils are commonly adjacent to Glynwood, Haskins, Pandora, and Pewamo soils and are similar to Bennington and Nappanee soils. Glynwood soils are better drained, and their subsoil is not so gray. Pandora and Pewamo soils are wetter and have a grayer subsoil. Pewamo soils also have a mollic epipedon. Bennington soils formed in glacial till lower in calcium carbonate equivalent, and they have significant amounts of shale fragments. Nappanee soils have more clay in the B and C horizons.

Typical pedon of Blount silt loam, 0 to 2 percent slopes, about 2 miles north of New Riegel, in Big Spring Township, 700 feet south and 200 feet west of the northeast corner of sec. 2, T. 1 N., R. 13 E.

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

B1—7 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure; firm; grayish brown (10YR 5/2) coatings on faces of peds; common fine roots; 1 percent coarse fragments; strongly acid; clear wavy boundary.

B21t—11 to 16 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct grayish brown (10YR 5/2) mottles; weak fine prismatic structure parting to strong medium angular blocky; firm; grayish brown (10YR 5/2) coatings on faces of peds; common roots; 2 percent coarse fragments; strongly acid; clear wavy boundary.

B22t—16 to 25 inches; brown (10YR 5/3) silty clay; common medium faint grayish brown (10YR 5/2) and few medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; medium continuous grayish brown (10YR 5/2) clay films on faces of peds; 2 percent coarse fragments; few roots; slightly acid; clear wavy boundary.

B3t—25 to 30 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films; 2 percent coarse fragments; slight effervescence; mildly alkaline.

C—30 to 60 inches; dark brown (10YR 4/3) silty clay loam; weak coarse prismatic structure parting to weak medium platy; firm; grayish brown (10YR 5/2) faces on plates; patchy light gray (10YR 7/1) lime concretions; 5 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness ranges from 20 to 45 inches but more commonly is 24 to 36 inches. The content of coarse fragments generally increases with depth and ranges from 0 in the Ap horizon to 12 percent by volume in the C horizon.

The Ap horizon is 7 to 10 inches thick. It has hue of 10YR, value of 4, and chroma of 1 or 2. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is silty clay loam, clay loam, clay, or silty clay. It ranges from medium acid or strongly acid in the upper part to neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is silty clay loam or clay loam.

Bono series

The Bono series consists of deep, very poorly drained soils formed in lacustrine sediment in flat or depressional areas of till plains. Permeability is slow or very slow. Slope is 0 to 2 percent.

Bono soils are commonly adjacent to Lenawee soils and are similar to Pandora and Pewamo soils. Lenawee soils do not have a mollic epipedon. Pandora and Pewamo soils formed in glacial till and have an argillic horizon. Pandora soils also have an ochric epipedon and less clay in the B horizon.

Typical pedon of Bono silty clay, loamy substratum, about 2 miles northwest of Attica, in Reed Township, 250 feet south and 1,000 feet west of the northeast corner of sec. 33, T. 2 N., R. 17 E.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silty clay; massive; firm; few roots; neutral; clear smooth boundary.

B1g—12 to 21 inches; gray (10YR 6/1) silty clay; common medium and fine distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; firm; common roots; gray (N 5/0) coatings on faces of peds; few dark gray (10YR 3/1) tongues from the Ap horizon; neutral; clear smooth boundary.

B2g—21 to 38 inches; gray (10YR 6/1) silty clay; few fine distinct yellowish brown (10YR 5/6) and coarse medium distinct light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure; firm; few roots; gray (N 5/0) coatings on faces of peds; neutral; clear smooth boundary.

C1—38 to 51 inches; gray (10YR 5/1) silty clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure; firm; few roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIC2—51 to 60 inches; gray (10YR 5/1) silt loam with thin strata of yellowish brown (10YR 5/6) fine sand; few fine distinct strong brown (7.5YR 5/8) mottles; friable; very few roots; slight effervescence; mildly alkaline.

Solum thickness ranges from 25 to 60 inches. Most pedons have a variable clay content because of stratification, but the control section typically averages more than 40 percent clay. Thin layers of silty clay loam or silt loam are in the solum or in the upper part of the substratum of some pedons. The solum is neutral or mildly alkaline.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 0 or 1. It is clay or silty clay. The C horizon is silty clay or silty clay loam in the upper part and silt loam with thin strata of fine sand in the lower part.

Carlisle series

The Carlisle series consists of deep, very poorly drained soils formed in organic deposits more than 5 feet thick. These soils are in depressions on uplands and terraces. Permeability ranges from moderately slow to moderately rapid. Slope is 0 to 2 percent.

Carlisle soils are commonly adjacent to Blount, Lenawee, Pandora, and Tiro soils and are similar to Linwood soils. Blount, Lenawee, Pandora, and Tiro soils formed mainly in mineral material. Linwood soils formed in a thinner organic deposit.

Typical pedon of Carlisle muck, about 1 mile south of Bloomville, in Bloom Township, 250 feet east and 250 feet south of the northwest corner of sec. 22, T. 1 N., R. 16 E.

Oa1—0 to 6 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fibers unrubbed and rubbed; moderate medium and fine granular structure; loose; many roots; neutral; clear smooth boundary.

Oa2—6 to 19 inches; black (10YR 2/1) broken face and rubbed sapric material; 20 percent fibers, none rubbed; weak coarse subangular blocky structure; very friable; few woody fragments; medium acid; clear smooth boundary.

Oa3—19 to 29 inches; black (10YR 2/1) broken face and rubbed sapric material; 10 percent fibers, none rubbed; massive; very friable; few woody fragments; medium acid; clear smooth boundary.

Oa4—29 to 39 inches; dark reddish brown (5YR 3/3) and dark brown (7.5YR 3/3) broken face; dark brown (7.5YR 3/2) rubbed sapric material; 30 percent fibers, less than 5 percent rubbed; massive; very friable; few woody fragments; medium acid; clear smooth boundary.

Oa5—39 to 58 inches; dark brown (7.5YR 3/3) broken face; black (5YR 2/1) rubbed sapric material; 20 percent fibers, less than 5 percent rubbed; massive; very friable; few woody fragments; medium acid; clear smooth boundary.

Oa6—58 to 60 inches; dark reddish brown (5YR 2/2) broken face; black (5YR 2/1) rubbed sapric material; 10 percent fibers, less than 5 percent rubbed; massive; very friable; few woody fragments; medium acid.

The organic material is more than 60 inches thick. The subsurface and bottom tiers range from medium acid to neutral.

The subsurface tier has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 3. The bottom tier has hue of 5YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3.

Chagrin series

The Chagrin series consists of deep, well drained, moderately permeable soils formed in alluvium on flood plains. These soils are subject to occasional flooding. Slope is 0 to 2 percent.

Chagrin soils are commonly adjacent to Ross and Shoals soils. Ross soils have a mollic epipedon. Shoals soils are wetter and have mottles just below the A horizon.

Typical pedon of Chagrin silt loam, occasionally flooded, about 7 miles south of Tiffin, in Seneca Township, 800 feet west and 450 feet north of the southeast corner of sec. 25, T. 1 N., R. 14 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam; weak medium and fine granular structure; friable; many roots; neutral; abrupt wavy boundary.

B21—9 to 19 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse subangular blocky structure; firm; few roots; brown (10YR 4/3) coatings in root channels and on faces of peds; neutral; diffuse smooth boundary.

B22—19 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse subangular blocky structure; firm; few roots; brown (10YR 4/3) coatings in root channels and on faces of peds; neutral; clear smooth boundary.

C1—28 to 41 inches; dark yellowish brown (10YR 4/4) silt loam; massive; friable; few roots; dark brown (10YR 4/3) coatings in root channels; diffuse smooth boundary.

C2—41 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; common fine faint yellowish brown (10YR 5/4) mottles; massive; friable; few roots; dark brown (10YR 4/3) coatings in root channels; neutral.

Solum thickness ranges from 24 to 48 inches. The content of coarse fragments to a depth of 40 inches is 0 to 10 percent by volume.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid to neutral. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly silt loam or loam, but in some pedons it has thin subhorizons of sandy loam and clay loam. It ranges from medium acid to neutral. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam, loam, or sandy loam.

Channahon series

The Channahon series consists of shallow, well drained, moderately permeable soils formed in glacial till and in some residuum of limestone bedrock in the lower part of the solum. Slope is 0 to 6 percent.

Channahon soils are commonly adjacent to Millsdale, Milton, Milton Variant, and Randolph soils. Millsdale, Milton, Milton Variant, and Randolph soils are moderately deep over limestone bedrock.

Typical pedon of Channahon silt loam, 2 to 6 percent slopes, about 3.5 miles south of Bettsville in Liberty Township, 2,250 feet west and 2,250 feet south of northeast corner of sec. 27, T. 3 N., R. 14 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium and fine granular structure; friable; many roots; neutral; clear smooth boundary.

B1—6 to 8 inches; dark yellowish brown (10YR 3/4) silt loam; weak medium and fine granular structure; friable; common roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; 1 percent coarse fragments; neutral; clear smooth boundary.

B2t—8 to 14 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium and fine granular structure; friable; common roots; dark brown (7.5YR 3/2) coatings on faces of peds; 12 percent coarse fragments; neutral; abrupt smooth boundary.

IIR—14 to 16 inches; brown (7.5YR 5/4) and white (10YR 8/2) limestone bedrock.

Solum thickness and depth to limestone bedrock range from 10 to 20 inches. The content of coarse fragments generally increases with depth and ranges from 0 in the Ap horizon to 14 percent by volume in the lower part of the solum.

The B horizon has hue of 10YR, value of 3 or 4, and chroma of 3 or 4. It is silt loam or silty clay loam.

Colwood series

The Colwood series consists of deep, very poorly drained, moderately permeable soils formed in loamy and silty water deposited sediment. These soils are on lake plains, outwash plains, and deltas. Slope is 0 to 2 percent.

Colwood soils are commonly adjacent to Hoytville, Nappanee, and Kibbie soils and are similar to Lenawee, Mermill, and Millgrove soils. Hoytville, Kibbie, Lenawee, Mermill, and Nappanee soils do not have a mollic epipedon, and Hoytville, Kibbie, Mermill, and Nappanee soils have an argillic horizon. Hoytville, Lenawee, and Nappanee soils have more clay in the subsoil. Mermill soils also have glacial till or lacustrine material in the substratum within a depth of 40 inches. Millgrove soils have more gravel in the subsoil and substratum.

Typical pedon of Colwood silt loam, near Bascom, in Hopewell Township, 2,190 feet east and 315 feet south of the northwest corner of sec. 18, T. 2 N., R. 14 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silt loam; moderate fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1g—11 to 13 inches; dark gray (10YR 4/1) light silty clay loam; few fine distinct dark brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; common roots; neutral; clear smooth boundary.

B21g—13 to 19 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) and few medium faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few roots; gray (10YR 5/1) coatings on faces of peds; dark gray (10YR 4/1) worm casts; neutral; clear smooth boundary.

B22g—19 to 24 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; gray (10YR 5/1) coatings on faces of peds; few concretions (Fe and Mn oxides); neutral; clear smooth boundary.

B23g—24 to 31 inches; grayish brown (10YR 5/2) silty clay loam; few medium distinct yellowish brown (10YR 5/6 and 5/4) mottles; weak medium prismatic structure; firm; light gray (10YR 6/1) coatings on faces of peds; neutral; clear smooth boundary.

B3g—31 to 40 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; few thin strata of clay loam; weak coarse prismatic structure; firm; light gray (10YR 6/1) coatings on faces of peds; neutral; gradual smooth boundary.

IIC1—40 to 52 inches; grayish brown (10YR 5/2) stratified fine sand and silt loam with lenses of very fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; neutral; clear smooth boundary.

IIC2—52 to 60 inches; brown (10YR 5/3) fine sandy loam; common medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; massive; firm; slight effervescence; mildly alkaline.

Solum thickness and depth to carbonates range from 50 to 55 inches. The solum is dominantly neutral or mildly alkaline; but some pedons have a slightly acid A horizon.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The B horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 or 2. It is dominantly silty clay loam and has thin strata of silt loam, fine sand, very fine sand, clay loam, or sandy clay loam. The C horizon is dominantly stratified silt loam, fine sandy loam, fine sand, silty clay loam, clay loam, or loamy fine sand.

Digby series

The Digby series consists of deep, somewhat poorly drained soils formed in loamy outwash on beach ridges and stream terraces. Permeability is moderate in the subsoil and rapid in the substratum. Slope is 1 to 4 percent.

Digby soils in Seneca County have less gravel in the substratum than is defined in the range for the series. This difference, however, does not alter the use or behavior of the soils.

Digby soils are commonly adjacent to Belmore, Gallman, Kibbie, and Millgrove soils and are similar to Haskins soils. Belmore and Gallman soils are better drained and do not have mottles just below the A horizon. Haskins soils formed in glacial outwash over glacial till or lacustrine material. Kibbie soils have a dark colored surface layer. Millgrove soils are wetter and have a mollic epipedon.

Typical pedon of Digby loam, 1 to 4 percent slopes, about 3 miles south of Green Springs, in Adams Township, 2,500 feet east and 500 feet north of the southwest corner of sec. 19, T. 3 N., R. 16 E.

Ap1—0 to 6 inches; dark grayish brown (10YR 4/2) loam; weak medium and fine granular structure; friable; common roots; 2 percent coarse fragments; neutral; abrupt smooth boundary.

Ap2—6 to 10 inches; dark brown (10YR 4/3) loam; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium and coarse subangular blocky structure; friable; common roots; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; 2 percent coarse fragments; neutral; abrupt smooth boundary.

B1—10 to 16 inches; brown (10YR 5/3) sandy clay loam; common medium distinct yellowish brown (10YR 5/8) and few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few roots; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; 3 percent coarse fragments; slightly acid; abrupt smooth boundary.

B21tg—16 to 20 inches; grayish brown (10YR 5/2) sandy clay loam; many coarse distinct yellowish brown (10YR 5/6), few fine distinct yellowish brown (10YR 5/8), and few fine faint light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; few thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 4 percent coarse fragments; slightly acid; abrupt smooth boundary.

B22tg—20 to 23 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/8) and few fine distinct dark brown (10YR 4/3) and yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

B23tg—23 to 27 inches; grayish brown (10YR 5/2) sandy clay loam; few fine distinct yellowish brown (10YR 5/8), common medium distinct yellowish brown (10YR 5/6), and few medium distinct dark brown (10YR 4/3) mottles; weak coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 10 percent coarse fragments; neutral; abrupt smooth boundary.

B24tg—27 to 34 inches; dark grayish brown (10YR 4/2) gravelly sandy loam; few medium distinct black (N 2/0) and few fine distinct reddish brown (5YR 4/4) and yellowish brown (10YR 5/4) mottles; weak medium and fine granular structure; friable; thin patchy dark grayish brown (10YR 4/2) clay films bridging sand grains; 20 percent coarse fragments; neutral; abrupt smooth boundary.

B31g—34 to 37 inches; grayish brown (10YR 5/2) sandy clay loam; few medium distinct dark reddish brown (5YR 3/3) and yellowish red (5YR 4/6) mottles; weak medium and fine granular structure; friable; grayish brown (10YR 5/2) coatings on faces of peds; 10 percent coarse fragments; neutral; abrupt smooth boundary.

C1—37 to 43 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and few fine distinct dark reddish brown (5YR 3/2) mottles; weak coarse platy structure; friable; grayish brown (10YR 5/2) coatings on faces of peds; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—43 to 50 inches; dark gray (10YR 4/1) sandy loam; few fine distinct yellowish brown (10YR 5/6) and reddish brown (5YR 4/4) mottles; weak coarse platy structure; friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C3—50 to 60 inches; grayish brown (10YR 5/2) sandy loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse and medium subangular blocky structure; friable; strong effervescence; moderately alkaline.

Solum thickness and depth to carbonates range from 28 to 48 inches. Gravel content ranges from 2 to 10 percent by volume in the upper part of the solum and from 10 to 20 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is neutral or slightly acid. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is clay loam, sandy clay loam, sandy loam, or loam and gravelly analogs of these textures. It is slightly acid or medium acid in the upper part and neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 4.

Fitchville series

The Fitchville series consists of deep, somewhat poorly drained, moderately slowly permeable soils. These soils formed in lake laid sediment on lake plains and terraces. Slope is 1 to 4 percent.

Fitchville soils are commonly adjacent to Digby, Haskins, and Nappanee soils and are similar to Sebring and Tiro soils. Digby and Haskins soils have more sand and coarse fragments in the subsoil. Nappanee soils formed in glacial till and have more clay in the subsoil. Sebring soils are wetter, and their subsoil is grayer. Tiro soils formed in lacustrine or alluvial sediment over glacial till.

Typical pedon of Fitchville silt loam, 1 to 4 percent slopes, about 1 mile east of McCutchenville, in Seneca Township, 1,700 feet west and 450 feet north of southeast corner of sec. 34, T. 1 N., R. 14 E.

Ap1—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam; weak medium and fine granular structure; friable; many roots; medium acid; abrupt smooth boundary.

Ap2—4 to 8 inches; dark brown (10YR 4/2) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine granular structure; friable; many roots; dark grayish brown (10YR 4/2) worm casts; medium acid; abrupt smooth boundary.

B1—8 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse and medium subangular blocky structure; friable; common roots; patchy dark grayish brown (10YR 4/2) coatings on faces of peds; strongly acid; clear smooth boundary.

B21t—16 to 24 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse and medium subangular blocky structure; firm; common roots; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy clay films on faces of peds; strongly acid; clear smooth boundary.

B22t—24 to 29 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; firm; common roots; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy clay films on faces of peds; medium acid; clear smooth boundary.

B23t—29 to 35 inches; brown (10YR 5/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy clay films on faces of peds; few very dark gray (10YR 3/1) concretions (Fe and Mn oxides); slightly acid; clear smooth boundary.

B24t—35 to 46 inches; brown (10YR 5/3) silt loam; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate coarse and medium subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) coatings on faces of peds; thin strata of clay loam; medium patchy clay films on faces of peds; neutral; abrupt smooth boundary.

B3—46 to 56 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct light brownish gray (10YR 6/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak coarse platy structure; firm; thin patchy light brownish gray (10YR 6/2) coatings on faces of peds; neutral; abrupt smooth boundary.

C—56 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct light brownish gray (10YR 6/2) and few medium distinct strong brown (7.5YR 5/6) mottles; friable; massive; 1 percent coarse fragments; pinkish gray (7.5YR 7/2) carbonate coatings in partings; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 60 inches.

The Ap horizon is strongly acid or medium acid. The Bt horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 4. It is silt loam or silty clay loam. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4.

Gallman series

The Gallman series consists of deep, well drained, moderately rapidly permeable soils. These soils formed in poorly sorted outwash material on outwash plains, stream terraces, and end moraines. Slope is 0 to 6 percent.

Gallman soils are commonly adjacent to Digby, Haney, and Spinks soils and are similar to Belmore and Milton Variant soils. Digby and Haney soils are wetter. Digby soils have low chroma mottles just below the A horizon, and Haney soils have mottles in the lower part of the subsoil. Belmore and Milton Variant soils have a thinner solum, and Milton Variant soils have limestone bedrock at a depth of 20 to 40 inches. Spinks soils have less silt, clay, and gravel in the subsoil and substratum.

Typical pedon of Gallman loam, 2 to 6 percent slopes, about 2.5 miles southeast of Attica, in Venice Township, 2,400 feet south and 100 feet east of the northwest corner of sec. 18, T. 1 N., R. 18 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) loam; moderate fine and medium granular structure; friable; many roots; 2 percent gravel; slightly acid; abrupt smooth boundary.

B1—10 to 18 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; many roots; few dark grayish brown (10YR 4/2) organic stains and fillings in root channels; 2 percent gravel; slightly acid; gradual smooth boundary.

B21—18 to 23 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; few roots; dark brown (7.5YR 4/4) coatings on faces of peds and fillings in root channels; 5 percent gravel; medium acid; abrupt smooth boundary.

B22t—23 to 27 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; friable; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds; 12 percent gravel; medium acid; abrupt smooth boundary.

IIB23t—27 to 57 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate medium and coarse subangular blocky structure; friable; thin patchy brown (7.5YR 5/2) clay films bridging sand grains and coating gravel; 20 percent coarse fragments; medium acid; abrupt smooth boundary.

IIB3—57 to 60 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; massive; friable; 15 percent coarse fragments; medium acid; abrupt smooth boundary.

Solum thickness ranges from 55 to 80 inches. Coarse fragment content ranges from 2 to 30 percent by volume in the B2 horizon and from 2 to 40 percent in the B3 horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is medium acid to neutral. The B1 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is sandy loam, loam, or silt loam. The B2t horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 or 4. It is sandy clay loam, loam, clay loam, or sandy loam and gravelly analogs of these textures. The B3 horizon has hue of 10YR, or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is sandy loam, sandy clay loam, loam, or loamy sand and gravelly analogs of these textures. The B horizon is very strongly acid to neutral in the upper part and medium acid to neutral in the lower part.

Glynwood series

The Glynwood series consists of deep, moderately well drained, slowly permeable soils. These soils formed on uplands in glacial till high in content of lime. Slope ranges from 0 to 12 percent.

Glynwood soils are commonly adjacent to Blount, Morley, Pandora, and Pewamo soils. Blount, Pandora, and Pewamo soils are wetter and have a grayer subsoil. Pewamo soils have a mollic epipedon. Morley soils are better drained, and their subsoil is not so gray.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, about 2 miles southeast of Flat Rock, in Thompson Township, 1,500 feet north and 125 feet east of the southwest corner of sec. 14, T. 3 N., R. 17 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam; moderate medium and fine granular structure; friable; many roots; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

B21t—9 to 15 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium and coarse subangular blocky structure; firm; common roots; thin patchy brown (10YR 5/3) clay films on faces of peds; common dark grayish brown (10YR 4/2) wormcasts; 3 percent coarse fragments; medium acid; clear smooth boundary.

B22t—15 to 22 inches; dark yellowish brown (10YR 4/4) silty clay; common fine distinct yellowish brown (10YR 5/6) and few fine distinct light brownish gray (10YR 6/2) mottles; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few roots; thin patchy brown (10YR 5/3) clay films on faces of peds; 3 percent coarse fragments; very strongly acid; clear smooth boundary.

B23t—22 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy brown (10YR 5/3) clay films on faces of peds; few black (10YR 2/1) concretions; 3 percent coarse fragments; neutral; clear smooth boundary.

B3t—29 to 36 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse and medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) coatings on faces of peds; very patchy thin brown (10YR 5/3) clay films on faces of peds; patchy light brownish gray (10YR 6/2) carbonate coatings on faces of peds; 6 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1—36 to 48 inches; dark yellowish brown (10YR 4/4) clay loam; few medium distinct grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate thick platy structure; firm; patchy light brownish gray (10YR 6/2) carbonate accumulations in partings; 7 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—48 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; few medium distinct grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate thick platy structure; firm; 6 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates range from 22 to 40 inches. The content of coarse fragments is 0 to 5 percent by volume in the upper part of the solum and 1 to 10 percent in the lower part and in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or silty clay loam. The B horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is clay loam, silty clay loam, silty clay, or clay. The B horizon is very strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The C horizon is silty clay loam or clay loam.

Haney series

The Haney series consists of deep, moderately well drained soils formed in loamy stratified material. These soils are on beach ridges, terraces, and outwash plains. Permeability is moderate in the subsoil and rapid in the substratum. Slope ranges from 0 to 12 percent.

Haney soils are commonly adjacent to Digby soils and are similar to Belmore, Gallman, and Rawson soils. Belmore, Gallman, and Rawson soils are better drained and do not have low chroma mottles in the upper part of the subsoil. Rawson soils formed in outwash over glacial till. Digby soils are wetter and have mottles just below the A horizon.

Typical pedon of Haney loam, 0 to 2 percent slopes, about 2 miles west of Attica, in Venice Township, 2,000 feet south and 800 feet west of the northeast corner of sec. 8, T. 1 N., R. 17 E.

Ap—0 to 11 inches; dark brown (10YR 4/3) loam; moderate fine granular structure; friable; many roots; 3 percent pebbles; neutral; abrupt smooth boundary.

B1—11 to 16 inches; dark yellowish brown (10YR 4/4) loam; common medium distinct brown (10YR 5/3) and few fine distinct strong brown (7.5YR 5/4 and 5/8) mottles; weak medium and fine subangular blocky structure; friable; common roots; 8 percent pebbles; slightly acid; clear smooth boundary.

B21t—16 to 21 inches; dark yellowish brown (10YR 4/4) sandy clay loam; few medium distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; 8 percent pebbles; medium acid; clear smooth boundary.

B22t—21 to 28 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; few fine distinct strong brown (7.5YR 5/8) and common medium distinct strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) mottles; weak medium and fine subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few shale fragments; 18 percent pebbles; medium acid; abrupt smooth boundary,

B3t—28 to 37 inches; dark brown (10YR 4/3) gravelly sandy clay loam; few fine distinct grayish brown (10YR 5/2), strong brown (7.5YR 5/8), and yellowish brown (10YR 5/6) mottles; massive; very friable; light brownish gray (10YR 6/2) clay films bridging sand grains; 30 percent gravel; neutral; clear smooth boundary.

C1—37 to 50 inches; yellowish brown (10YR 5/4) gravelly sandy loam; few medium distinct light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/8) mottles; massive; very friable; 40 percent gravel; neutral; abrupt smooth boundary.

C2—50 to 60 inches; dark grayish brown (10YR 4/2) sandy loam; few fine prominent strong brown (7.5YR 5/6) mottles; massive; loose; neutral.

Solum thickness ranges from 24 to 48 inches. The gravel content ranges from 2 to 15 percent by volume in the upper part of the B horizon and from 10 to 40 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid to neutral. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is mainly loam, clay loam, or sandy clay loam and gravelly analogs of these textures. The B2 horizon is slightly acid to strongly acid, and the B3 horizon is slightly acid to mildly alkaline. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4.

Haskins series

The Haskins series consists of deep, somewhat poorly drained soils formed in glacial outwash over glacial till or lacustrine material. These soils are on terraces, beach ridges, and till plains. Permeability is moderate in the outwash and slow or very slow in the underlying material. Slope is 0 to 6 percent.

Haskins soils are commonly adjacent to Blount, Kibbie, Mermill, Nappanee, and Rawson soils and are similar to Digby and Tiro soils. Blount and Nappanee soils formed in glacial till and have more clay in the argillic horizon. Kibbie and Digby soils formed in glacial outwash and do not have moderately fine textured material in the substratum. Mermill soils have a mollic epipedon, and they have dominant chroma of 2 or less between the A horizon and a depth of 30 inches. Rawson soils are better drained, and their subsoil is not so gray. Tiro soils have more silt and less sand and gravel in the upper part of the solum.

Typical pedon of Haskins loam, 2 to 6 percent slopes, about 2 miles southwest of Republic, in Scipio Township, 630 feet east and 750 feet north of southwest corner of sec. 28, T. 2 N., R. 16 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam; weak medium and fine granular structure; friable; few roots; 1 percent coarse fragments; neutral; clear smooth boundary.

B1—7 to 14 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; friable; few roots; thin patchy pale brown (10YR 6/3) coatings on faces of peds; 5 percent coarse fragments; medium acid; abrupt smooth boundary.

B21t—14 to 16 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; light brownish gray (10YR 6/2) coatings on faces of peds; thin patchy pale brown (10YR 6/3) clay films on faces of peds; 12 percent coarse fragments; medium acid; clear smooth boundary.

B22t – 16 to 20 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and common medium distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; light brownish gray (10YR 6/2) coatings and clay films on faces of peds; 12 percent coarse fragments; strongly acid; clear smooth boundary.

B2t – 20 to 25 inches; brown (10YR 5/3) gravelly clay loam; common medium distinct strong brown (7.5YR 5/6), common fine distinct yellowish brown (10YR 5/6), and few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; thin patchy light brownish gray (10YR 6/2) clay films and gray (10YR 6/1) coatings on faces of peds; 17 percent coarse fragments; neutral; abrupt smooth boundary.

IIB3 – 25 to 31 inches; yellowish brown (10YR 5/4) heavy silty clay loam; few medium distinct light brownish gray (10YR 6/2) and few fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy gray (10YR 6/1) coatings of faces of peds; 10 percent coarse fragments; neutral; clear smooth boundary.

IIC – 31 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; very firm; 5 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness ranges from 26 to 42 inches.

The A horizon is neutral to strongly acid. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is clay loam, sandy clay loam, or loam and gravelly analogs of these textures. The IIB horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 4. It is silty clay loam or clay loam. The B horizon is slightly acid to strongly acid in the upper part and slightly acid to mildly alkaline in the lower part. The C horizon is silty clay loam or clay loam.

Hoytville Series

The Hoytville series consists of deep, very poorly drained, slowly permeable soils formed in glacial till on lake plains. Slope is 0 to 2 percent.

Hoytville soils are similar to Pewamo soils and are commonly adjacent to Colwood, Kibbie, Mermill, Millsdale, and Nappanee soils. Colwood and Kibbie soils have more sand and less clay throughout the soil, and Mermill soils have less clay in the upper part of the B horizon. Colwood and Pewamo soils have a molic epipedon, and Colwood soils do not have an argilic horizon. Kibbie and Nappanee soils are better drained and have an ochric epipedon. Millsdale soils have limestone bedrock at a depth of 20 to 40 inches.

Typical pedon of Hoytville silty clay loam, about 3 miles southeast of Bettsville, in Liberty Township, 200 feet west and 2,500 feet north of the southeast corner of sec. 17, T.3 N., R. 14 E.

Ap1 – 0 to 7 inches; very dark gray (10YR 3/1) silty clay loam; weak coarse granular structure; firm; common roots; neutral; abrupt smooth boundary.

Ap2 – 7 to 9 inches; very dark gray (10YR 3/1) silty clay loam; common medium distinct yellowish brown (10YR5/6), few fine distinct strong brown (7.5YR 5/6), and common medium distinct gray (5YR 5/1) mottles; moderate medium subangular blocky structure; firm; common roots; neutral; abrupt smooth boundary.

B21tg – 9 to 20 inches; grayish brown (10YR 5/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 1 percent coarse fragments; very dark gray (10YR 3/1) worm casts and fillings in root channels; neutral; clear smooth boundary.

B22tg – 20 to 29 inches; grayish brown (10YR 5/2) silty clay; few medium, faint gray (10YR 5/1), many medium distinct yellowish brown (10YR 5/6), and common medium distinct brown (7.5YR 4/4) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; common roots; thin patchy gray (10YR 5/1), clay films on faces of peds; dark brown (7.5YR 3/2) manganese concretions; 2 percent coarse fragments; neutral; clear smooth boundary.

B23tg – 29 to 38 inches; gray (10YR 5/1) clay; common medium faint grayish brown (10YR 5/2, many medium distinct strong brown (7.5YR 5/6), and few medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium and coarse angular blocky; firm; common roots; medium patchy gray (10YR 5/1) clay films on faces of peds; 2 percent coarse fragments; neutral; clear smooth boundary.

B3t – 30 to 47 inches; grayish brown (10YR 5/2) silty clay; common medium distinct dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure; firm; few roots; thin patchy gray (10YR 5/1) clay films on faces of peds; 3 percent coarse fragments; dark brown (7.5YR 3/2) manganese concretions; neutral; clear smooth boundary.

C1 – 47 to 54 inches; grayish brown (10YR 5/2) clay loam; many medium distinct yellowish brown (10YR 5/6), common medium distinct dark brown (7.5YR

4/4), and few fine faint olive yellow (2.5Y 6/6) mottles; weak coarse subangular blocky structure; firm; gray (10YR 6/1) coatings in partings; 4 percent coarse fragments; dark brown (7.5YR 3/2) manganese concretions; slight effervescence; mildly alkaline; clear smooth boundary.

C2—54 to 60 inches; gray (10YR 5/1) silty clay loam; common medium distinct brown (7.5YR 5/2) and many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; gray (10YR 6/1) coatings on faces of peds; 4 percent coarse fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 45 to 50 inches. The content of coarse fragments commonly increases in size and amount with depth and is 2 to 8 percent by volume throughout the soil. Reaction is neutral or slightly acid in the A horizon and upper part of the B horizon and neutral or mildly alkaline in the lower part of the B horizon.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly silty clay loam but is silty clay in some pedons. The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is clay or silty clay. The C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 to 3. It is silty clay loam, clay loam, or clay.

Kibbie series

The Kibbie series consists of deep, somewhat poorly drained, moderately permeable soils. These soils formed in loamy and sandy glaciofluvial deposits on lake plains. Slope is 0 to 2 percent.

Kibbie soils are commonly adjacent to Colwood, Haskins, Hoytville, and Millgrove soils and are similar to Digby soils. Colwood, Hoytville, and Millgrove soils are wetter, and they have dominantly low chroma between the A horizon and a depth of 30 inches. Colwood and Millgrove soils also have a mollic epipedon. Digby and Haskins soils have a lighter colored surface layer. Digby soils formed in loamy outwash on beach ridges and stream terraces. Haskins soils formed in medium textured and moderately fine textured glacial outwash over glacial till or lacustrine material on terraces, beach ridges, and till plains.

Typical pedon of Kibbie fine sandy loam, 0 to 2 percent slopes, about 2 miles southwest of Green Springs, in Adams Township, 1,250 feet east and 1,300 feet north of the southwest corner of sec. 18, T. 3 N., R. 16 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) fine sandy loam; weak coarse granular structure; friable; common roots; neutral; abrupt smooth boundary.

B21t—8 to 15 inches; yellowish brown (10YR 5/4) sandy clay loam; few medium distinct dark yellowish brown (10YR 3/4) mottles; weak coarse and medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 10 percent coarse fragments; neutral; clear smooth boundary.

B22t—15 to 20 inches; yellowish brown (10YR 5/4) heavy loam; few medium distinct yellowish brown (10YR 5/8) and few medium distinct grayish brown (10YR 5/2) mottles; weak coarse and medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 5 percent coarse fragments; neutral; clear smooth boundary.

B23t—20 to 29 inches; dark brown (10YR 4/3) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak coarse and medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 2 percent coarse fragments; neutral; clear wavy boundary.

B3—29 to 34 inches; brown (10YR 5/3) sandy clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; grayish brown (10YR 5/2) coatings on faces of peds; neutral; abrupt smooth boundary.

C—34 to 60 inches; yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) stratified silt loam and very fine sandy loam; few medium distinct brownish yellow (10YR 6/6) mottles; massive; friable; slight effervescence; mildly alkaline.

Solum thickness and depth to carbonates range from 28 to 48 inches. The solum is slightly acid or neutral.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is heavy loam, sandy clay loam, or silt loam. The C horizon has hue of 10YR, value of 5, and chroma of 2 to 4. It is stratified sandy loam, very fine sandy loam, silt loam, fine sand, or very fine sand.

Lenawee series

The Lenawee series consists of deep, very poorly drained, moderately slowly permeable soils. These soils formed in lacustrine deposit in flat or depressional areas of lake plains and till plains. Slope is 0 to 2 percent.

Lenawee soils are commonly adjacent to Bono, Pandora, and Tiro soils and are similar to Colwood and Hoytville soils. Bono and Colwood soils have a mollic epipedon. Colwood soils have more sand and less clay in the subsoil. Hoytville and Pandora soils formed in glacial till. Hoytville soils also have illitic mineralogy. Pandora soils have a lighter colored surface layer. Tiro soils are better drained, and they do not have chroma of 2 dominant between the A horizon and a depth of 30 inches.

Typical pedon of Lenawee silty clay loam, about 2 miles southeast of Attica, in Venice Township, 2,000 feet west and 2,250 feet south of the northeast corner of sec. 13, T. 1 N., R. 17 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium and fine subangular blocky structure; firm; many roots; slightly acid; clear smooth boundary.

B21g—9 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct dark brown (7.5YR 4/4) and few fine distinct dark reddish brown (5YR 3/4) mottles; moderate medium subangular blocky structure; firm; many roots; neutral; clear wavy boundary.

B23g—22 to 33 inches; gray (10YR 5/1) silty clay; many medium distinct dark yellowish brown (10YR 4/4) and common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; firm; few very dark brown (10YR 2/1) concretions (Fe and Mn oxides); neutral; clear smooth boundary.

B24g—33 to 45 inches; grayish brown (10YR 5/2) heavy silty clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine prominent dark reddish brown (5YR 3/4) mottles; weak coarse prismatic structure; firm; few roots; thin patchy very dark brown (10YR 2/2) coatings on vertical faces of peds; neutral; gradual wavy boundary.

IIB3g—45 to 53 inches; grayish brown (10YR 5/2) heavy clay loam; common medium distinct strong brown (7.5YR 5/8) and few fine distinct dark reddish brown (5YR 3/4) mottles; massive; firm; dark gray (10YR 4/1) vertical partings; 2 percent coarse fragments; neutral; gradual wavy boundary.

IIC—53 to 60 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct dark gray (10YR 4/1) mottles; massive; friable; gray (N 4/0) vertical partings; 2 percent coarse fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 55 inches. The solum is slightly acid or neutral.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The B horizon has hue of 10YR to 5Y or is neutral. It has value of 4 to 6 and chroma of 1 or 2. It is silty clay, heavy silty clay loam, or heavy clay loam. The IIC horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 6.

Linwood series

The Linwood series consists of deep, very poorly drained, moderately permeable, organic soils. These soils formed on till plains in 16 to 51 inches of organic deposit over loamy mineral material. Slope is 0 to 2 percent.

Linwood soils are commonly adjacent to Colwood, Millgrove, and Millsdale soils and are similar to Carlisle soils. Carlisle soils formed in a thicker organic deposit. Colwood, Millgrove, and Millsdale soils formed mainly in mineral material. Millsdale soils also have limestone bedrock at a depth of 20 to 40 inches.

Typical pedon of Linwood muck, about 1 mile west of Springville, in Big Spring Township, 1,600 feet west and 100 feet north of the southeast corner of sec. 30, T. 1 N., R. 13 E.

Oa1—0 to 12 inches; black (N 2/0) broken face and rubbed sapric material; 30 percent fibers, none rubbed; weak medium granular structure; friable; many roots; slightly acid; clear smooth boundary.

Oa2—12 to 20 inches; black (N 2/0) broken face and rubbed sapric material; few fine distinct dark reddish brown (5YR 3/3) mottles; 30 percent fibers, none rubbed; weak medium and coarse subangular blocky structure; friable; many roots; strongly acid; clear smooth boundary.

Oa3—20 to 25 inches; very dark gray (5Y 3/1) broken face and rubbed sapric material; few fine distinct dark reddish brown (5YR 3/3) mottles; weak coarse subangular blocky structure; friable; few roots; 1 percent wood fibers; strongly acid; clear smooth boundary.

IIC1g—25 to 33 inches; dark gray (N 4/0) fine sandy loam; few fine distinct dark grayish brown (2.5Y 4/2) mottles; massive; friable; medium acid; clear smooth boundary.

IIC2g—33 to 41 inches; gray (N 5/0) silt loam; massive; friable; neutral; clear smooth boundary.

IIC3g—41 to 60 inches; dark gray (N 4/0) fine sandy loam; massive; friable; neutral.

Thickness of the organic material ranges from 16 to 25 inches. Some pedons have woody fragments in the organic material.

The surface tier has hue of 10YR or is neutral. It has value of 2 and chroma of 0 or 1. The subsurface tier has hue of 2.5Y or 5Y or is neutral. It has value of 2 or 3 and chroma of 0 to 3 both broken face and rubbed. It is strongly acid to slightly acid. The IICg horizon has hue of 10YR to 5Y or is neutral. It has value of 4 or 5 and chroma of 0 to 2. It is fine sandy loam, silt loam, or loam. It has loamy sand strata that are less than 10 inches thick in some pedons. It is medium acid to mildly alkaline.

Mermill series

The Mermill series consists of deep, very poorly drained soils formed in outwash or alluvium and the underlying glacial till or lacustrine material on lake plains. Permeability is moderate through the subsoil and slow or very slow in the underlying material. Slope is 0 to 2 percent.

Mermill soils are commonly adjacent to Haskins, Hoytville, and Rawson soils and are similar to Colwood and Millgrove soils. Colwood soils formed in water deposited sediment, and they have less clay in the lower part of the B horizon and in the C horizon. Haskins and Rawson soils are better drained, and they don not have dominantly low chromas between the Ap horizon and a depth of 30 inches. Hoytville soils formed in glacial till, and their subsoil is higher in clay content. Millgrove soils have a mollic epipedon and coarser textured material in the substratum.

Typical pedon of Mermil loam, about 3 miles northeast of Fostoria, in Jackson Township, 2,125 feet east and 600 feet south of the northwest corner of sec. 21, T. 3 N., R. 13 E.

Ap – 0 to 7 inches; very dark grayish brown (10YR 3/2) loam; weak coarse granular structure; friable; common roots; slightly acid; clear smooth boundary.

B1 – 7 to 10 inches; dark gray (10YR 4/1) clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; common roots; neutral; clear smooth boundary.

B21tg – 10 to 19 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; strong coarse and medium subangular blocky structure; firm; few roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; 6 percent coarse fragments; neutral; abrupt smooth boundary.

B22tg – 19 to 25 inches; grayish brown (10YR 5/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/8) mottles; weak medium and fine granular structure; friable; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 5 percent coarse fragments; neutral; clear smooth boundary.

B23tg – 25 to 30 inches; grayish brown (10YR 5/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium and fine subangular blocky structure; friable; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 10 percent coarse fragments; neutral; abrupt smooth boundary.

B3tg – 30 to 35 inches; dark grayish brown (10YR 4/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; weak medium and fine subangular blocky structure; friable; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 10 percent coarse fragments; neutral; abrupt smooth boundary.

IIC – 35 to 60 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct yellowish brown (10YR 5/4), common coarse faint dark yellowish brown (10YR 4/4), and few medium distinct gray (10YR 5/1) mottles; weak coarse platy structure; firm; strong effervescence; moderately alkaline.

Solum thickness ranges from 24 to 48 inches. The depth to the IIC horizon ranges from 20 to 40 inches.

The AP horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is sandy clay loam or clay loam. It ranges from medium acid to mildly alkaline. Some pedons have a IIB horizon of silty clay loam or clay loam. The IIC horizon has hue of 10YR, value of 4 or 5, cha chroma of 1 to 3.

Millgrove Series

The Millgrove series consitst of deep, very poorly drained, moderately permieable soils formed in loamy water laid sediment. These soils are on beach ridges, terraces, and outwash plains. Slope is 0 to 2 percent.

Millgrove soils are commonly adjacent to Digby, Hoytville, and Kibbie soils and are similar to Colwood and Mermill soils. Colwood soils do not have an argillic horizon, and they have less coarse fragments. Digby and Kibbie soils are better drained, and they do not have dominantly low chroma between the A horizon and a depth of 30 inches. Hoytville and Mermil soils do not have a mollic epipedon.

Typical pedon of Milgrove loam, about 3 miles south of Green Springs, in Adams Township, 690 feet south and 500 feet east of the northwest corner of sec. 30, T. 3 N., R. 16 E.

Ap1 – 0 to 6 inches; very dark grayish brown (10YR 3/2) loam; weak fine granular structure; friable; common roots; neutral; clear smooth boundary.

Ap2 – 6 to 11 inches; very dark grayish brown (10YR 3/2) sandy clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse and medium subangular blocky structure; friable; common roots; 1 percent coarse fragments; neutral; abrupt smooth boundary.

B1g – 11 to 13 inches; dark grayish brown (10YR 4/2) sandy clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse and medium subangular blocky structure; friable; few roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; 1 percent coarse fragments; neutral; abrupt smooth boundary.

B21tg – 13 to 23 inches; grayish brown (10YR 5/2) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct brownish yellow (10YR 6/6) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; thin patchy grayish brown (10YR 5/2) clay films bridging sand grains; 4 percent coarse fragments; neutral; clear smooth boundary.

B22tg – 23 to 28 inches; grayish brown (10YR 5/2) gravelly sandy clay loam; fine few distinct yellowish brown (10YR 5/4) and few medium distinct strong brown (7.5YR 5/8) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) clay films bridging sand grains; 15 percent coarse fragments; neutral; clear smooth boundary.

B23tg—28 to 37 inches; grayish brown (10YR 5/2) sandy clay loam; few medium distinct brownish yellow (10YR 6/6) and strong brown (7.5YR 5/8) and common medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; friable; few roots; light brownish gray clay films bridging sand grains; 4 percent coarse fragments; neutral; abrupt smooth boundary.

B31g—37 to 41 inches; dark grayish brown (10YR 4/2) gravelly sandy clay loam; common medium distinct yellowish brown (10YR 5/6 and 5/8) and common fine faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; 25 percent coarse fragments; neutral; abrupt smooth boundary.

B32—41 to 46 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; friable; neutral; abrupt smooth boundary.

C—46 to 60 inches; gray (10YR 5/1) sandy loam with thin strata of silty clay loam; common medium distinct dark brown (10YR 4/3), yellowish brown (10YR 5/6), and light brownish gray (10YR 6/2) mottles; massive; friable; dark grayish brown (10YR 4/2) worm casts; 10 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

Solum thickness ranges from 31 to 46 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly loam but is silt loam and fine sandy loam in places. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is dominantly sandy clay loam or clay loam and gravelly analogs of these textures. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 4. It is sandy loam, loamy sand, sandy clay loam, or clay loam. Thin strata of silty clay loam are in many pedons.

Millsdale series

The Millsdale series consists of moderately deep, very poorly drained, moderately slowly permeable soils on uplands and lake plains. These soils formed in glacial till and in the lower part of the solum in some residuum of limestone bedrock. Slope is 0 to 2 percent.

The Millsdale soils in Seneca County have a thinner, darker colored surface layer than is defined in the range of the series. This difference, however, does not alter the use or behavior of the soils.

Millsdale soils are commonly adjacent to Blount, Hoytville, Pandora, and Randolph soils and are similar to Pewamo soils. Blount, Hoytville, Pandora, and Pewamo soils are deep over bedrock. Randolph soils have an ochric epipedon.

Typical pedon of Millsdale silty clay loam, near Flat Rock, in Thompson Township, 2,000 feet north and 2,000 feet west of the southeast corner of sec. 12, T. 3 N., R. 17 E.

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

B1g—8 to 13 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4) and few medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; neutral; gradual smooth boundary.

B21tg—13 to 18 inches; gray (N 5/0) silty clay loam; common medium distinct yellowish brown (10YR 5/4) and light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few roots; thin patchy gray (N 5/0) clay films on faces of peds; neutral; clear smooth boundary.

B22tg—18 to 24 inches; gray (N 5/0) clay loam; many medium distinct yellowish brown (10YR 5/6) and few medium distinct brown (10YR 5/3) mottles; weak coarse and medium subangular blocky structure; firm; few roots; thin patchy gray (N 5/0) clay films on faces of peds; few very dark brown (10YR 2/2) and black (10YR 2/1) concretions (Fe and Mn oxides); neutral; clear smooth boundary.

B31g—24 to 28 inches; grayish brown (2.5Y 5/2) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

B32—28 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; massive; firm; gray (N 5/0) calcium carbonate accumulations in partings; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIR—35 to 37 inches; limestone bedrock.

Solum thickness and depth to bedrock range from 20 to 40 inches.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The upper part of the B horizon has hue of 10YR or 2.5Y or is neutral. It has value of 3 to 6 and chroma of 0 to 2. The lower part has hue of 10YR or 2.5Y or is neutral. It has value of 4 or 5 and chroma of 1 to 4. The B horizon is silty clay loam or clay loam. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

Milton series

The Milton series consists of moderately deep, well drained soils on uplands and lake plains. These soils formed in glacial till and in the lower part of the solum in some residuum of limestone bedrock. Permeability is moderate or moderately slow. Slope is 0 to 6 percent.

Milton soils are commonly adjacent to Channahon, Glynwood, and Randolph soils and are similar to Milton Variant soils. Channahon soils have a mollic epipedon and are shallow over bedrock. Glynwood soils are deep over bedrock. Milton Variant soils formed in glacial outwash and in some residuum of limestone bedrock, and they have more sand and gravel in the subsoil. Randolph soils are wetter and have mottles in the upper part of the subsoil.

Typical pedon of Milton silt loam, 0 to 2 percent slopes, near Flat Rock, in Thompson Township, 1,200 feet south and 2,050 feet east of the northwest corner of sec. 12, T. 3 N., R. 17 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

A2—10 to 13 inches; brown (10YR 5/3) silt loam; moderate medium and thick platy structure; firm; few fine black (10YR 2/1) and very dark brown (10YR 2/2) concretions; common roots; neutral; clear smooth boundary.

B21t—13 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; common roots; slightly acid; clear smooth boundary.

IIB22t—17 to 21 inches; dark yellowish brown (10YR 4/4) silty clay; strong medium subangular blocky structure; firm; medium continuous dark brown (10YR 4/3) clay films on faces of peds; slightly acid; abrupt smooth boundary.

IIR—21 to 23 inches; limestone bedrock.

Solum thickness ranges from 20 to 40 inches but is typically 20 to 30 inches. The solum is slightly acid or neutral.

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

Milton Variant

The Milton Variant consists of moderately deep, well drained, moderately permeable soils on stream terraces. These soils formed in glacial outwash and in the lower part of the solum in some residuum of limestone bedrock. Slope is 0 to 6 percent.

Milton Variant soils are commonly adjacent to Belmore, Gallman, and Glynwood soils and are similar to Belmore, Gallman, and Milton soils. Belmore, Gallman, and Glynwood soils are deep over bedrock. Milton soils formed in glacial till and residuum of limestone bedrock, and they have more clay and less gravel and sand in the subsoil.

Typical pedon of Milton Variant loam, 0 to 2 percent slopes, about 1 mile northwest of Bloomville, in Bloom Township, 625 feet east and 1,750 feet south of the northwest corner of sec. 9, T. 1 N., R. 16 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) loam; weak medium and coarse granular structure; friable; many roots; 2 percent coarse fragments; neutral; clear smooth boundary.

B1—9 to 16 inches; dark yellowish brown (10YR 4/4) clay loam; moderate coarse subangular blocky structure; friable; common roots; thin patchy dark brown (10YR 3/3) coatings on faces of peds; 2 percent coarse fragments; neutral; gradual wavy boundary.

B21t—16 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; friable; common roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 2 percent coarse fragments; neutral; gradual wavy boundary.

B22t—22 to 25 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse and medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; about 8 percent coarse fragments; neutral; clear smooth boundary.

IIB23t—25 to 33 inches; dark brown (10YR 4/3) gravelly clay loam; few medium distinct strong brown (7.5YR 5/6) mottles; weak coarse and medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 25 percent coarse fragments; few fine black (10YR 2/1) concretions (Fe and Mn oxides); neutral; clear smooth boundary.

IIB3t—33 to 38 inches; dark yellowish brown (10YR 3/4) gravelly clay loam; common coarse distinct light brownish gray (10YR 6/2), few fine distinct yellowish brown (10YR 5/6), and few medium distinct light olive brown (2.5Y 5/4) mottles; weak coarse and medium subangular blocky structure; friable; few roots; thin patchy dark brown (10YR 4/3) clay films coating coarse fragments; 45 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

IIIR—38 inches; limestone bedrock.

Solum thickness ranges from 20 to 40 inches. The content of coarse fragments ranges from 2 to 10 percent in the upper part of the solum and from 20 to 50 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is medium acid or neutral. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 to 6. It is loam, clay loam, or sandy clay loam and in the lower part of most pedons gravelly analogs of these textures. Reaction is medium acid to neutral in the upper part and medium acid to mildly alkaline in the lower part.

Morley series

The Morley series consists of deep, well drained, moderately slowly permeable or slowly permeable soils.

These soils formed in clay loam or silty clay loam glacial till on uplands. Slope ranges from 12 to 50 percent.

Morley soils are commonly adjacent to Glynwood and Rawson soils and are similar to Milton soils. Glynwood soils are wetter and have mottling closer to the surface. Milton soils have limestone bedrock at a depth of 20 to 40 inches. Rawson soils formed in glacial outwash over glacial till.

Typical pedon of Morley silt loam, 12 to 18 percent slopes, eroded, about 1 mile northwest of Bloomville, in Bloom Township, 700 feet east and 1,125 feet south of the northwest corner of sec. 9, T. 1 N., R. 16 E.

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

B21—4 to 9 inches; brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin dark brown (10YR 3/3) coatings on faces of peds; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

B22t—9 to 17 inches; brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; firm; common roots; medium patchy dark brown (10YR 4/3) clay films on faces of peds; a few black (10YR 2/1) concretions (Fe and Mn oxides); 3 percent coarse fragments; medium acid; abrupt smooth boundary.

B23t—17 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; few roots; medium patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; 3 percent coarse fragments; slightly acid; abrupt smooth boundary.

B3t—22 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; few fine black (10YR 2/1) concretions (Fe and Mn oxides); thin patchy brown (10YR 4/3) clay films on faces of peds; 8 percent coarse fragments; neutral; abrupt smooth boundary,

C1—24 to 36 inches; dark yellowish brown (10YR 4/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm; thin patchy light gray (10YR 7/2) carbonate coatings in partings; 10 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—36 to 60 inches; brown (10YR 5/3) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm; thin patchy grayish brown (10YR 5/2) coatings in partings; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness ranges from 22 to 40 inches. The content of coarse fragments generally increases with depth and ranges from 0 in the Ap horizon to 14 percent by volume in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or silty clay loam. It is medium acid to neutral. The C horizon is silty clay loam or clay loam.

Nappanee series

The Nappanee series consists of deep, somewhat poorly drained, very slowly permeable soils. These soils formed in silty clay or heavy silty clay loam glacial till on lake plains. Slope is 0 to 6 percent.

Nappanee soils are similar to Bennington and Blount soils and are commonly adjacent to Colwood, Fitchville, Haskins, and Hoytville soils. Bennington and Blount soils have less clay in the lower part of the B horizon and in the C horizon. Bennington soils also formed in glacial till lower in calcium carbonate equivalent, and they have significant amounts of sandstone and shale fragments. Colwood and Hoytville soils are wetter and have a grayer subsoil. Colwood soils also have a mollic epipedon, and Hoytville soils a darker colored surface layer. Fitchville soils have more silt and less clay in the B and C horizons. Haskins soils formed in outwash over glacial till or lacustrine material.

Typical pedon of Nappanee silt loam, 0 to 2 percent slopes, about 2 miles southwest of Bettsville, in Liberty Township, 1,750 feet south and 20 feet west of the northeast corner of sec. 17, T. 3 N., R. 14 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak medium and fine granular structure; friable; neutral; abrupt smooth boundary.

B21t—7 to 14 inches; brown (10YR 5/3) silty clay; many medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; abrupt smooth boundary.

B22t—14 to 18 inches; grayish brown (10YR 5/2) silty clay; many medium distinct yellowish brown (10YR 5/4), common medium distinct yellowish brown (10YR 5/6), and common medium distinct brown (10YR 4/3) mottles; moderate coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; common concretions (Fe and Mn oxides); neutral; abrupt smooth boundary.

B3t—18 to 26 inches; grayish brown (10YR 5/2) silty clay; many medium distinct yellowish brown (10YR 5/6) and common medium faint brown (10YR 5/3) mottles; moderate coarse prismatic structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 1 percent coarse fragments; many fine black (10YR 2/1) concretions (Fe and Mn oxides); neutral; clear smooth boundary.

C1—26 to 37 inches; grayish brown (10YR 5/2) heavy silty clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; thin patchy light gray calcium carbonate coatings in partings; 2 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C2—37 to 60 inches; yellowish brown (10YR 5/4) heavy silty clay loam; many medium distinct gray (10YR 5/1) and common medium faint yellowish brown (10YR 5/6) mottles; moderate coarse platy structure; firm; thin patchy very pale brown (10YR 7/3) calcium carbonate coatings in partings; strong effervescence; moderately alkaline.

Solum thickness and depth to carbonates ranges from 18 to 42 inches and is commonly 24 to 35 inches. The content of coarse fragments generally increases with depth and ranges from 0 in the Ap horizon to 5 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. It is silty clay or heavy silty clay loam. It is neutral in the upper part and neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 5, and chroma of 1 to 4. It is heavy silty clay loam or silty clay.

Oshtemo series

The Oshtemo series consists of deep, well drained soils formed in loamy and sandy glaciofluvial deposits on outwash plains and end moraines. Permeability is moderately rapid in the solum and very rapid in the substratum. Slope is 2 to 6 percent.

Oshtemo soils are commonly adjacent to Gallman soils and are similar to Gallman and Belmore soils. Belmore and Gallman soils have more clay in the argillic horizon. Gallman soils also have a thicker solum.

Typical pedon of Oshtemo sandy loam, 2 to 6 percent slopes, about 5 miles south of Tiffin, in Seneca Township, 1,500 feet south and 1,000 feet west of the northeast corner of sec. 23, T. 1 N., R. 14 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1—9 to 18 inches; brown (10YR 4/3) sandy loam; weak fine and medium subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

B21t—18 to 30 inches; reddish brown (5YR 4/3) sandy loam; moderate medium subangular blocky structure; friable; thin patchy clay films bridging sand grains; few roots; strongly acid; clear smooth boundary.

B31—30 to 33 inches; dark brown (7.5YR 4/4) loamy sand; single grained; loose; strongly acid; abrupt smooth boundary.

B32t—33 to 45 inches; reddish brown (5YR 4/3) gravelly sandy clay loam; massive; friable; medium patchy clay films bridging sand grains; medium acid; clear irregular boundary.

IIC—45 to 60 inches; brown (10YR 5/3) gravelly sand; single grained; loose; strong effervescence; mildly alkaline.

Solum thickness ranges from 40 to 66 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The A horizon is dominantly sandy loam but is loamy sand in some areas. The Bt horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 or 4. It is sandy loam, sandy clay loam, or gravelly sandy loam. Some pedons have thin subhorizons of loamy sand in the lower part of the solum. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3.

Pandora series

The Pandora series consists of deep, poorly drained, slowly permeable soils formed in glacial till on uplands. Slope is 0 to 2 percent.

Pandora soils are commonly adjacent to Bennington, Blount, and Glynwood soils and are similar to Lenawee, Millsdale, and Pewamo soils. Bennington, Blount, and Glynwood soils are better drained, and their subsoil is not so gray. Lenawee soils formed in lacustrine deposit and do not have an argillic horizon. Pewamo soils have a mollic epipedon. Millsdale soils are underlain by limestone bedrock at a depth of 20 to 40 inches.

Typical pedon of Pandora silt loam, about 6 miles southwest of Tiffin, in Hopewell Township, 1,800 feet east and 2,000 feet north of the southwest corner of sec. 33, T. 2 N., R. 14 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) rubbed silt loam, light brownish gray (10YR 6/2) dry; weak medium and coarse granular structure; friable; many roots; neutral; abrupt smooth boundary.

B1g—7 to 11 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common roots; neutral; clear smooth boundary.

B21tg—11 to 23 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark brown (10YR 4/3) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few roots; thin dark gray (10YR 4/1) coatings on faces of peds; thin patchy clay films on faces of peds; few coarse fragments; neutral; clear smooth boundary.

B22tg—23 to 38 inches; gray (10YR 5/1) clay loam; common medium distinct yellowish brown (10YR 5/6) and dark brown (10YR 4/3) mottles; moderate coarse prismatic structure; firm; thin dark gray (10YR

4/1) coatings on faces of peds; thin patchy clay films on faces of peds; about 2 percent coarse fragments; neutral; clear smooth boundary.

B3—38 to 55 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct gray (10YR 5/1) and common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin patchy gray (10YR 5/1) coatings on faces of peds; about 5 percent coarse fragments; slight effervescence in the lower part; mildly alkaline; gradual smooth boundary.

C—55 to 60 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct dark brown (7.5YR 4/4) and gray (10YR 5/1) mottles; massive; firm; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness typically is 50 to 60 inches and ranges from 40 to 70 inches. The content of coarse fragments is 0 to 5 percent by volume throughout the soil.

The Ap horizon has hue of 10YR, value of 4 moist and 6 dry, and chroma of 1 or 2. Some pedons have an uncrushed color of very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). The Ap horizon is slightly acid or neutral. The B2 horizon has hue of 10YR to 5Y or N, value of 4 to 6, and chroma of 0 to 2. It is silty clay loam, silty clay, clay loam, or clay. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The B3 horizon is silty clay loam or clay loam. It 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 silty clay loam or clay loam.

Pewamo series

The Pewamo series consists of deep, very poorly drained, moderately slowly permeable soils formed in glacial till on uplands. Slope is 0 to 2 percent.

Pewamo soils are adjacent to Blount, Bono, Glynwood, and Pandora soils and are similar to Hoytville and Millsdale soils. Blount and Glynwood soils are better drained, and their subsoil is not so gray. Blount, Glynwood, Hoytville, Lenawee, Millsdale, and Pandora soils do not have a mollic epipedon. Bono soils formed in lacustrine sediment, and they have less coarse fragments in the subsoil and substratum. Millsdale soils have limestone bedrock at a depth of 20 to 40 inches.

Typical pedon of Pewamo silty clay loam, about 1.5 miles northwest of New Riegel, in Big Spring Township, 300 feet west and 1,750 feet north of the southeast corner of sec. 2, T. 1 N., R. 13 E.

Ap1—0 to 4 inches; very dark gray (10YR 3/1) silty clay loam; very dark grayish brown (10YR 3/2) rubbed; strong medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

Ap2—4 to 9 inches; very dark gray (10YR 3/1) silty clay loam; very dark grayish brown (10YR 3/2) rubbed; strong medium angular blocky structure; firm; common roots; slightly acid; abrupt smooth boundary.

A13—9 to 13 inches; very dark gray (10YR 3/1) silty clay loam; very dark grayish brown (2.5Y 3/3) rubbed; common fine faint very dark grayish brown (2.5Y 3/2) and common fine distinct olive brown (2.5Y 4/4) mottles; weak medium angular blocky structure; firm; common roots; slightly acid; abrupt smooth boundary.

B21tg—13 to 21 inches; gray (5Y 5/1) heavy silty clay loam; common medium prominent dark brown (10YR 4/3) mottles; moderate fine angular blocky structure; firm; dark gray (10YR 4/1) coatings and very patchy very dark gray (10YR 3/1) clay films on faces of peds; few roots; slightly acid; clear smooth boundary.

B22tg—21 to 32 inches; gray (5Y 5/1) heavy silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; very patchy gray (5Y 5/1) clay films on faces of peds; few roots; 2 percent pebbles; neutral; gradual smooth boundary.

B23g—32 to 41 inches; gray (10YR 5/1) heavy silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; gray (5Y 5/1) vertical ped faces; 4 percent pebbles; neutral; clear smooth boundary.

B31—41 to 50 inches; yellowish brown (10YR 5/4) heavy silty clay loam; many medium distinct gray (10YR 5/1) mottles; weak coarse angular blocky structure; firm; 3 percent pebbles; neutral; gradual smooth boundary.

B32—50 to 60 inches; dark brown (10YR 4/3) heavy silty clay loam; common medium distinct gray (10YR 5/1) mottles; gray (10YR 5/1) vertical channels; weak coarse angular blocky structure; firm; 4 percent pebbles; neutral; gradual smooth boundary.

Solum thickness ranges from 36 to 70 inches. Mollic epipedon thickness ranges from 11 to 14 inches. Coarse fragments generally increase in size and amount with depth and are 1 to 14 percent by volume.

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 B2 horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or clay loam. Reaction of the B horizon increases with depth and ranges from slightly acid in the upper part to mildly alkaline in the lower part.

Randolph series

The Randolph series consists of moderately deep, somewhat poorly drained, moderately slowly permeable soils on uplands. These soils formed in glacial till and in some residuum of limestone bedrock in the lower part of the solum. Slope is 0 to 2 percent.

Randolph soils are commonly adjacent to Channahon, Millsdale, and Milton soils and are similar to Blount soils. Blount soils are deep over bedrock. Channahon soils are shallow over bedrock and have a mollic epipedon. Millsdale soils are wetter and have a grayer subsoil. Milton soils are better drained and do not have 2 chroma mottles in the subsoil.

Typical pedon of Randolph silt loam, 0 to 2 percent slopes, near Flat Rock, in Thompson Township, 2,125 feet east and 1,500 feet south of the northwest corner of sec. 12, T. 3 N., R. 17 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium and fine granular structure; friable; many roots; 2 percent pebbles; slightly acid; abrupt smooth boundary.

B1—9 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; few medium distinct light brownish gray (10YR 6/2) and few medium faint dark brown (10YR 4/4) mottles; moderate medium and fine subangular blocky structure; friable; common roots; 2 percent pebbles; strongly acid; clear wavy boundary.

B21t—11 to 15 inches; yellowish brown (10YR 5/4) heavy silty clay loam; few medium faint yellowish brown (10YR 5/6) and few medium distinct grayish brown (10YR 5/2) mottles; weak coarse and medium prismatic structure parting to strong medium and fine angular blocky; firm; common roots; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy clay films on faces of peds; 2 percent coarse fragments; strongly acid; clear smooth boundary.

B22t—15 to 23 inches; yellowish brown (10YR 5/4) heavy silty clay loam; few medium faint yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to strong medium and fine angular blocky; firm; few roots; continuous medium gray (10YR 5/1) clay films on faces of peds; 2 percent pebbles; neutral; abrupt smooth boundary.

B3—23 to 33 inches; dark grayish brown (10YR 4/2) heavy silty clay loam; few medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; massive; firm; 5 percent pebbles; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIR—33 to 36 inches; limestone bedrock.

Solum thickness and depth to a lithic contact range from 20 to 40 inches.

The B horizon has hue of 10YR or 2.5Y and value of 4 or 5. It has dominant chroma of 3 or 4 but has chroma of 1 or 2 in some subhorizons. The B2 horizon is heavy clay loam or heavy silty clay loam. The B horizon is strongly acid to slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

Rawson series

The Rawson series consists of deep, moderately well drained and well drained soils on beach ridges, terraces, and till plains. These soils formed in glacial outwash over glacial tills. Permeability is moderate through the subsoil and slow or very slow in the underlying material. Slope is 2 to 6 percent.

Rawson soils are commonly adjacent to Digby, Haney, Haskins, and Mermill soils and are similar to Gallman and Glynwood soils. Digby, Haney, and Gallman soils formed in glacial outwash. They do not have the contrasting moderately fine textured glacial till within a depth of 40 inches. Glynwood soils formed in glacial till. Haskins and Mermill soils are wetter, and they have dominant chroma of 2 or less either on faces of peds or in the matrix between the A horizon and a depth of 30 inches.

Typical pedon of Rawson loam, 2 to 6 percent slopes, about 2 miles southwest of Flat Rock, in Thompson Township, 500 feet north and 250 feet east of the southwest corner of sec. 14, T. 3 N., R. 17 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

B1t—10 to 19 inches; yellowish brown (10YR 5/6) clay loam; moderate medium and fine subangular blocky structure; friable; common roots; thin patchy yellowish brown (10YR 5/6) clay films bridging sand grains; 10 percent coarse fragments; slightly acid; clear smooth boundary.

B21t—19 to 23 inches; yellowish brown (10YR 5/6) gravelly loam; massive; friable; common roots; thin patchy yellowish brown (10YR 5/6) clay films bridging sand grains; 15 percent coarse fragments; strongly acid; clear wavy boundary.

B22t—23 to 31 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; massive; friable; few roots; thin patchy yellowish brown (10YR 5/6) clay films bridging sand grains; 30 percent coarse fragments; very strongly acid; abrupt smooth boundary.

IIB3t—31 to 40 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6), few medium distinct brownish yellow (10YR 6/8), and few medium distinct grayish brown (10YR 5/2) mottles; moderate coarse and medium subangular blocky structure; firm; thin patchy pale brown (10YR 6/3) clay films on faces of peds; 5 percent coarse fragments; neutral; clear smooth boundary.

IIC1—40 to 51 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/8) mottles; weak medium platy structure; firm; light brownish gray (10YR 6/2) calcium carbonate accumulations in partings; 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

IIC2—51 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/8) mottles; weak medium platy structure; firm; 8 percent coarse fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 41 inches. Gravel content ranges from 2 to 30 percent by volume in the upper and middle parts of the solum and from 5 to 10 percent in the lower part and in the underlying material.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is neutral to strongly acid. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, gravelly clay loam, gravelly loam, or loam. The IIB3 horizon is clay loam or silty clay loam. The B horizon is slightly acid to very strongly acid in the upper and middle parts and slightly acid to mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or silty clay loam.

Rimer series

The Rimer series consists of deep, somewhat poorly drained soils on beach ridges and till plains. These soils formed in rapidly permeable sandy deposit over slowly permeable or very slowly permeable, moderately fine textured glacial till or lacustrine material. Slope is 0 to 2 percent.

Rimer soils are commonly adjacent to Seward soils and are similar to Digby, Haskins, and Blount soils. Digby soils do not have contrasting moderately fine textured material within a depth of 40 inches. Haskins soils have more clay and gravel in the upper part of the B horizon. Blount soils formed in glacial till, and they have argillic horizons that have more clay. Seward soils do not have low chroma mottles in the upper part of the subsoil.

Typical pedon of Rimer loamy sand, 0 to 2 percent slopes, about 9 miles west of Tiffin, in London Township, 1,000 feet north and 1,125 feet east of the southwest corner of sec. 26, T. 2 N., R. 13 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loamy sand; weak fine granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—9 to 14 inches; brown (10YR 5/3) loamy sand; common medium distinct yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; very friable; many roots; strongly acid; clear smooth boundary.

B1—14 to 23 inches; dark yellowish brown (10YR 4/4) loamy sand; few medium distinct light brownish gray (2.5Y 6/2) and common medium distinct pale brown (10YR 6/3) and yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; many roots; strongly acid; clear smooth boundary.

B2t—23 to 36 inches; dark yellowish brown (10YR 4/4) sandy loam; many medium distinct grayish brown (2.5Y 5/2) and common medium distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; friable; common roots; thin patchy dark yellowish brown (10YR 4/4) clay films bridging sand grains; neutral; abrupt smooth boundary.

IIB3t—36 to 42 inches; brown (10YR 4/3) clay loam; many medium distinct gray (5Y 5/1) and common medium distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; firm; few roots; thin patchy dark yellowish brown (10YR 4/4) clay films on vertical faces of peds; 4 percent coarse fragments; neutral; clear smooth boundary.

IIC1—42 to 51 inches; brown (10YR 4/3) silty clay loam; common medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/8) mottles; massive; firm; common vertical light gray (10YR 7/2) calcium carbonate accumulations; 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC2—51 to 60 inches; brown (10YR 4/3) silty clay loam; massive; firm; 5 percent coarse fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 24 to 48 inches. Thickness of the loamy fine sand or fine sand is 20 to 32 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. It is strongly acid to neutral. The A2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam or sandy loam and is strongly acid to neutral. The IIBt horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 3. It is silty clay loam or clay loam and is slightly acid to mildly alkaline.

Ross series

The Ross series consists of deep, well drained, moderately permeable soils on flood plains and low stream terraces. These soils formed in alluvium and are subject to occasional flooding. Slope is 0 to 2 percent.

The Ross soils in Seneca County have a thinner mollic epipedon than is defined in the range of the series. This difference, however, does not alter the use or behavior of the soils.

Ross soils are commonly adjacent to Chagrin and Shoals soils and are similar to Chagrin soils. Chagrin soils have an ochric epipedon. Shoals soils are wetter and have low chroma mottles closer to the surface.

Typical pedon of Ross silt loam, occasionally flooded, about 5 miles south of Tiffin in Seneca Township, 2,250 feet east and 750 feet north of the southwest corner of sec. 13, T. 1 N., R. 14 E.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium and fine granular structure; friable; many roots; neutral; clear smooth boundary.

A12—12 to 22 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate coarse and medium granular structure; friable; common roots; neutral; clear smooth boundary.

B2—22 to 28 inches; dark brown (10YR 4/3) silt loam; weak coarse and medium subangular blocky structure; friable; few roots; neutral; clear smooth boundary.

C1—28 to 44 inches; dark yellowish brown (10YR 4/4) loam; few medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; few roots; neutral; clear smooth boundary.

C2—44 to 60 inches; dark yellowish brown (10YR 4/4) loam; few medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; neutral.

Solum thickness ranges from 24 to 40 inches. Mollic epipedon thickness ranges from 13 to 24 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is slightly acid or neutral. The B2 horizon has hue of 10YR, value of 4, and chroma of 3 or 4. It is silt loam or loam. It is slightly acid or neutral.

Sebring series

The Sebring series consists of deep, poorly drained, moderately slowly permeable soils formed on uplands in water laid deposits in depressions and along drainageways. Slope is 0 to 2 percent.

Sebring soils are commonly adjacent to Bennington, Blount, Lenawee, and Tiro soils and are similar to Fitchville and Tiro soils. Bennington, Blount, Fitchville, and Tiro soils are better drained, and their subsoil is not so gray. Bennington and Blount soils formed in glacial till, and Tiro soils in lacustrine or alluvial sediment over glacial till. Lenawee soils have more clay in the subsoil and do not have an argillic horizon.

Typical pedon of Sebring silt loam, about 1 mile north of Republic, in Scipio Township, 740 feet west and 1,690 feet south of the northeast corner of sec. 16, T. 2 N., R 16 E.

Ap1—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate coarse granular structure; friable; many roots; neutral; abrupt smooth boundary.

Ap2—9 to 14 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint yellowish brown (10YR 5/6) mottles; moderate coarse granular structure; firm; many roots; slightly acid; abrupt smooth boundary.

B1g—14 to 26 inches; grayish brown (10YR 5/2) silt loam; few fine distinct brown (7.5YR 4/4) and yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure; firm; common roots; few black (10YR 2/1) stains; few gray (10YR 5/1) worm casts; medium acid; abrupt smooth boundary.

B21tg—26 to 30 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct brown (7.5YR 4/4) mottles; moderate medium prismatic structure; firm; few roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; medium acid; abrupt smooth boundary.

B22tg—30 to 39 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; thin patchy light gray (10YR 6/1) silt coatings and thin patchy gray (10YR 5/1) clay films on faces of peds; medium acid; gradual smooth boundary.

B23t—39 to 48 inches; grayish brown (10YR 5/2) silty clay loam; many fine distinct yellowish brown (10YR 5/8) mottles; moderate coarse angular blocky structure; firm; thin patchy gray (10YR 5/1) clay films on faces of peds; few black (10YR 2/1) stains; slightly acid; abrupt smooth boundary.

C—48 to 60 inches; gray (10YR 6/1) silt loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; few black (10YR 2/1) concretions (Fe and Mn oxides); neutral.

Solum thickness ranges from 30 to 50 inches.

The B2 horizon has hue of 10YR, value of 4 to 6, and chroma of 0 to 2. It is silty clay loam or silt loam. It is medium acid or slightly acid. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 4. It is stratified with silt loam, clay loam, or silty clay loam. It is neutral or mildly alkaline.

Seward series

The Seward series consists of deep, moderately well drained soils formed in water laid sandy and loamy deposits and the underlying glacial till. These soils are on beach ridges, end moraines, and stream terraces. Permeability is rapid in the upper part of the profile and slow or very slow in the underlying material. Slope is 0 to 6 percent.

Seward soils are commonly adjacent to Rimer and Haskins soils and are similar to Haney, Rawson, and Spinks soils. Rimer and Haskins soils are wetter and have mottles throughout the subsoil. Haney and Spinks soils do not have contrasting moderately fine textured material within a depth of 40 inches. Rawson soils do not have layers of loamy fine sand in the upper part of the soil.

Typical pedon of Seward loamy fine sand, 0 to 2 percent slopes, near Flat Rock, in Thompson Township, 1,750 feet east and 500 feet north of the southeast corner of sec. 12, T. 3 N., R. 17 E.

Ap—0 to 12 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine subangular blocky structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—12 to 20 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure;

very friable; many roots; neutral; gradual smooth boundary.

B1—20 to 29 inches; dark brown (7.5YR 4/4) loamy fine sand; very weak medium subangular blocky structure; loose; common roots; neutral; gradual smooth boundary.

B21t—29 to 33 inches; dark brown (7.5YR 4/4) fine sandy loam; massive; friable; common roots; thin patchy dark brown (7.5YR 4/4) clay films bridging sand grains; neutral; clear smooth boundary.

B22t—33 to 37 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium distinct strong brown (7.5YR 5/6) and few medium prominent gray (10YR 6/1) mottles; massive; friable; few roots; thin patchy gray (10YR 6/1) clay films coating sand grains; neutral; abrupt smooth boundary.

IIB3—37 to 40 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; few roots; 5 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

IIC—40 to 60 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; few partings of light gray (10YR 7/2) calcium carbonate accumulations; slight effervescence; mildly alkaline.

Solum thickness ranges from 24 to 48 inches. The loamy fine sand layer ranges from 20 to 32 inches in thickness. Reaction is slightly acid or neutral in the upper and middle parts of the solum and slightly acid to mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The B1 horizon has hue of 10YR or 7.5YR and value and chroma of 4 to 6. It is loamy fine sand or fine sand. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is fine sandy loam or sandy loam.

Shoals series

The Shoals series consists of deep, somewhat poorly drained, moderately permeable soils formed in alluvium eroded mainly from uplands and terraces. These soils are on flood plains and are subject to frequent flooding. Slope is 0 to 2 percent.

Shoals soils are commonly adjacent to Chagrin, Fitchville, and Ross soils. Chagrin and Ross soils are better drained and do not have mottles just below the A horizon. Ross soils have a mollic epipedon. Fitchville soils formed in lake laid sediment, they have more silt in the subsoil and substratum, and they are not subject to flooding.

Typical pedon of Shoals silt loam, frequently flooded, about 3.5 miles west of Tiffin, in Hopewell Township, 2,125 feet east and 750 feet north of the southwest corner of sec. 22, T. 2 N., R. 14 E.

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

C1—8 to 12 inches; grayish brown (10YR 5/2) loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium subangular blocky structure; friable; few roots; grayish brown (10YR 5/2) coatings on faces of peds; few black (10YR 2/1) stains (Fe and Mn oxides); neutral; gradual smooth boundary.

C2—12 to 17 inches; dark brown (10YR 4/3) loam; many medium distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) and dark brown (7.5YR 4/4) mottles; weak medium and fine granular structure; friable; few roots; few black (10YR 2/1) stains (Fe and Mn oxides); neutral; gradual smooth boundary.

C3—17 to 32 inches; grayish brown (10YR 5/2) loam; common medium faint brown (10YR 5/3) and common medium distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; weak medium and fine granular structure; friable; few roots; few black (10YR 2/1) stains (Fe and Mn oxides); neutral; gradual smooth boundary.

C4—32 to 40 inches; dark yellowish brown (10YR 4/4) loam; common coarse distinct grayish brown (10YR 5/2) and common medium distinct strong brown (7.5YR 5/6) and pale brown (10YR 6/3) mottles; massive; friable; few black (10YR 2/1) stains (Fe and Mn oxides); neutral; clear smooth boundary.

C5—40 to 60 inches; grayish brown (10YR 5/2) light clay loam; common medium distinct yellowish brown (10YR 5/6), pale brown (10YR 6/3), and dark brown (7.5YR 4/4) mottles; massive; friable; neutral; clear smooth boundary.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is slightly acid to mildly alkaline. The C horizon to a depth of about 40 inches has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam, loam, or clay loam. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

Spinks series

The Spinks series consists of deep, well drained soils formed in sandy deposit on beach ridges and end moraines. Permeability is moderately rapid or rapid. Slope is 2 to 6 percent.

Spinks soils are commonly adjacent to Belmore, Gallman, Kibbie, Rimer, and Seward soils and are similar to Seward soils. Belmore and Gallman soils have more gravel and coarse sand throughout, and they do not have lamellae. Kibbie and Rimer soils are wetter and have mottles throughout the subsoil. Seward and Rimer soils have contrasting moderately fine textured material within a depth of 40 inches.

Typical pedon of Spinks loamy sand, 2 to 6 percent slopes, about 3 miles south of Green Springs, in Adams Township, 750 feet north and 1,250 feet east of the southwest corner of sec. 18, T. 3 N., R. 16 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) loamy sand; weak fine granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—9 to 21 inches; pale brown (10YR 6/3) and yellowish brown (10YR 5/4) loamy sand; weak medium and fine subangular blocky structure; friable; common roots; neutral; abrupt smooth boundary.

A&Bt1—21 to 45 inches; pale brown (10YR 6/3) and yellowish brown (10YR 5/6) loamy sand; weak fine granular structure; very friable; common roots; dark brown (7.5YR 4/4) light sandy loam lamellae, 1/2 inch to 4 inches thick; clay films bridging sand grains in lamellae; neutral; abrupt smooth boundary.

A&Bt2—45 to 90 inches; yellowish brown (10YR 5/4) loamy sand; weak fine granular structure; very friable; dark brown (7.5YR 4/4) light sandy loam lamellae, 1/2 inch to 4 inches thick; clay films bridging sand grains in lamellae; neutral.

The solum typically ranges from medium acid to neutral, but some pedons are mildly alkaline in the lower part of the A horizon and in the B horizon. The content of coarse fragments is 0 to 5 percent by volume throughout the soil.

The A2 horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is loamy sand or fine sand. The A part of the A&B horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is loamy sand or fine sand. The B part of the A&B horizon has hue of 7.5YR, value of 4 or 5, and chroma of 4 to 6. The individual bands or lamellae of the B horizon range from loamy sand to light sandy loam. They range from 1/8 inch to 5 inches in thickness and are spaced 5 to 10 inches apart. They have a combined thickness of more than 6 inches.

Tiro series

The Tiro series consists of deep, somewhat poorly drained soils formed on till plains in lacustrine or alluvial sediment over glacial till. Permeability is moderate in the upper part of the solum and moderately slow or slow in the lower part and in the substratum. Slope is 0 to 6 percent.

The Tiro soils in Seneca County have a greater depth to glacial till than is defined in the range of the series. This difference, however, does not alter the use or behavior of the soils.

Tiro soils are commonly adjacent to Bennington, Pandora, and Lenawee soils and are similar to Fitchville and Haskins soils. Bennington soils have more clay in the upper part of the solum. Pandora and Lenawee soils are wetter and are in depressions and along drainageways. They have dominantly low chroma between the Ap horizon and a depth of 30 inches. Fitchville soils lack a lithologic discontinuity within a depth of 40 inches. Haskins soils have more sand and gravel in the upper part of the solum.

Typical pedon of Tiro silt loam, 0 to 2 percent slopes, about 3 miles south of Attica, in Venice Township, 1,875 feet east and 500 feet north of the southwest corner of sec. 22, T. 1 N., R. 17 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium and fine granular structure; friable; neutral; abrupt smooth boundary.

B1—9 to 12 inches; brown (10YR 5/3) light silty clay loam; common medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin continuous grayish brown (10YR 5/2) coatings on faces of peds; medium acid; clear smooth boundary.

B21t—12 to 21 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy grayish brown (10YR 5/2) clay films on faces of peds and in pores; few black (10YR 2/1) concretions (Fe and Mn oxides); medium acid; clear smooth boundary.

B22t—21 to 30 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; grayish brown (10YR 5/2) coatings on faces of peds; thin patchy grayish brown (10YR 5/2) clay films on faces of peds and in pores; slightly acid; clear smooth boundary.

IIB23t—30 to 41 inches; yellowish brown (10YR 5/4) clay loam; common medium faint yellowish brown (10YR 5/6) and few fine distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; light brownish gray (10YR 6/2) coatings on faces of peds; thin patchy clay films on faces of peds and in pores; 2 percent coarse fragments; neutral; clear smooth boundary.

IIB3—41 to 48 inches; yellowish brown (10YR 5/4) clay loam; common fine faint yellowish brown (10YR 5/6) and few fine distinct light brownish gray (10YR 6/2) mottles; weak medium prismatic structure; firm; light brownish gray (10YR 6/2) coatings on faces of peds; 5 percent coarse fragments; neutral; abrupt smooth boundary.

IIIC—48 to 60 inches; yellowish brown (10YR 5/4) clay loam; common coarse faint yellowish brown (10YR 5/6) mottles; massive; firm; light brownish gray (10YR 6/2) streaks in vertical partings; common light gray (10YR 7/2) calcium carbonate concretions; 5 percent coarse fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 48 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is neutral to medium acid. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. It is silty clay loam or silt loam in the upper part and clay loam or silty clay loam in the lower part. Reaction is neutral to strongly acid in the upper part and slightly acid to mildly alkaline in the lower part. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam or clay loam.

Formation of the soils

This section describes the factors of soil formation, relates them to the formation of soils in Seneca County, and explains some of the processes of soil formation.

Factors of soil formation

The major factors in soil formation are parent material, climate, relief, living organisms, and time.

Climate and living organisms, particularly vegetation, are the active forces in soil formation. Their effect on parent material is modified by relief and time. The importance of each factor differs from place to place. One factor can dominate and determine most of the soil properties, but normally it is the interaction of all five factors that determines what kind of soil forms in any given place.

Parent material

The soils of Seneca County formed in glacial till, glacial outwash, lacustrine deposits, recent alluvium, and accumulated organic material.

Glacial till, a term applied to extensive glacial deposits, is the most extensive of the parent materials in the county. The upland soils formed in glacial till. Bennington, Blount, Glynwood, Hoytville, Morley, Nappanee, and Tiro soils are examples. The till is fairly homogenous and uniform in texture. The soils formed in this material have a moderately fine textured or fine textured subsoil.

Outwash sand and gravel was deposited in the county by melt water along the glacial streams and on beach ridges. Much of this fairly well sorted coarse material was covered by finer textured loamy outwash. Gallman and Digby soils, for example, formed in glacial outwash. Gallman soils have a dark brown and dark yellowish brown subsoil because drainage is good. Digby soils are mottled with gray because the water table is high and aeration is poor during part of the year.

Areas of lacustrine material, on lake bottom sediment, are moderately extensive in the county. The interlayered silty to sandy characteristics of the parent material in these areas is reflected in the substratum of Kibbie and Colwood soils.

Alluvial, or flood water, deposits are the youngest parent materials in the county. This material is still accumulating as fresh sediment is added by the overflow of streams. The sediment is from the surface layer of the higher lying soils in the county and from exposures of glacial till. Chagrin soils, which are deep, fertile, and medium acid to neutral formed in alluvial material.

Organic material has accumulated in a few scattered areas. It consists mainly of decomposed remains of trees, sedges, and grasses in depressions and drainageways where the water table is high and where seepage keeps the area permanently wet. The material is strongly acid to neutral. Carlisle soils formed in this material.

Climate

The climate of Seneca County is uniform enough that it has not contributed greatly to differences among the soils. It has been favorable for physical change and chemical weathering of parent material and for biological activity.

Rainfall has been adequate for percolating water to leach carbonates to a moderate depth in many soils, Glynwood and Blount soils, for example. The frequency of rainfall has caused wet and dry cycles that favor the translocation of clay minerals and formation of soil structure, as in Glynwood and Gallman soils, for example.

The range of temperature variations has favored physical change and chemical weathering of parent material. Freezing and thawing has aided the formation of soil structure, and warm temperature in summer has favored chemical reactions in the weathering of primary minerals.

Rainfall and temperature have been conducive to plant growth and the accumulation of organic matter in all soils.

More information on the climate is given under "General nature of the survey area."

Relief

Relief can account for the formation of different soils from the same kind of parent material. Glynwood, Blount, and Pandora soils all formed in glacial till. The moderately well drained Glynwood soils have a moderately thick solum. They generally formed in areas that were neither too steep for excessive erosion nor so flat that they prevented runoff. The somewhat poorly drained Blount soils formed in areas where runoff is slow or medium. The poorly drained Pandora soils formed in swales where some organic residue accumulates because the water table is high most of the year. Glynwood and Blount soils are dominant in the morainic areas. The nearly level and gently sloping Blount and Pandora soils are dominant on till plains.

Living organisms

At the time Seneca County was settled, the vegetation was predominantly hardwood forest. Beech, maple, oak, hickory, and ash were dominant. Grassy clearings occurred on marshy openings in the poorly drained swales.

Soils that formed in forested areas are generally acid and moderate or low in natural fertility. They include Glynwood, Blount, and Nappanee soils. The marshy swales are very poorly drained, dark fertile soils, such as Bono, Colwood, and Lenawee soils.

Small animals, insects, worms, and roots form channels that make the soil more permeable. Animals mix the soil material and contribute organic matter. Crawfish channels are common in the poorly drained Pandora soils.

Plowing, planting, and vegetative changes also affect soil development. Some areas are drained, and some are irrigated. In some the soil has been removed for construction purposes. The use of lime and fertilizer changes the chemistry of the soils. Each of these activities, in its own way, affects the future formation of soils.

Time

Time is needed before the effects of the other soil forming factors are evident. The age of a soil is indicated to some extent by the degree of profile formation. In many places, factors other than time have been responsible for most of the differences in kind and distinctness of horizons in the different soils. If the parent material weathers slowly, the profile forms slowly. If slopes are steep and soil is removed almost as fast as it forms, no distinct horizons form.

Most soils in the county have well developed profiles. Examples are Glynwood, Blount, and Gallman soils. On the flood plains, deposits of fresh sediment periodically interrupt the soil forming process. Chagrin and Shoals soils on flood plains are examples of soils in which horizons are not well expressed.

Processes of soil formation

Most soils in Seneca County have a strongly expressed profile, in which the processes of soil formation produce very distinct changes in the material from which the soils were derived. These are the undulating soils formed in glacial till on till plains and in glacial outwash on terraces along the major valleys. In contrast, the soils on the flood plains are only slightly modified from the parent material.

All the factors of soil formation act in unison to control the processes by which horizons form. These processes are additions, removals, transfers, and transformations (*8*). Some promote horizon differentiation, but others retard or obliterate differences that are already present.

In this region the most evident addition to the soil is organic matter. Soils that formed where a high water table has restricted decomposition of organic matter have a deep, dark colored surface layer. The surface layer is high in organic matter and has good structure. Base saturation exceeds 50 percent. Examples of such soils are Colwood and Millgrove soils. Some organic matter accumulates as a thin surface mat in most soils but is usually obliterated by cultivation. Severe erosion can remove all evidence of this addition to the soil profile.

Leaching of carbonates from calcareous parent material is one of the most significant losses that precedes many other chemical changes in the solum. Most of the glacial till in Seneca County has a high content of carbonates, —15 to 25 percent. In most soils carbonates have been leached to a depth of 2 feet or more. Thus, the upper 2 feet of most soils is now acid. Other minerals in the soil are subjected to the same chemical weathering, but their resistance is higher and removal is slower. Following the removal of carbonates, alteration of such minerals as biotite and feldspar results in color changes within the profile. The free iron oxides may be segregated by a fluctuating high water table, which causes gray colors and mottles, as in Pandora soils, for example. Unless the water table is seasonally high within the profile, brownish colors of stronger chroma or redder hue than those in the C horizon are typical.

Seasonal wetting and drying of the soil is largely responsible for the transfer of clay from the A horizon to the ped surfaces in the B horizon. The fine clay is suspended in percolating water moving through the A horizon. It is carried by water to the B horizon. There, the fine clays are deposited on ped surfaces by drying or by precipitation of free carbonates. The transfer of fine clay accounts for the patchy or nearly continuous clay films on ped faces in the B horizon of such soils as Glynwood and Milton soils.

Transformations of mineral compounds occur in most soils. The result is most apparent if the formation of horizons is not affected by rapid erosion or accumulation of material at the surface. The primary silicate minerals are weathered chemically to produce secondary minerals, mainly those of the layer-lattice silicate clays. Most of the layer-lattice clays remain in the soil profile, but clay from the A horizon is transferred to deeper horizons.

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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.

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.

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.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

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.

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 (or contour farming). 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.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock. Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fast intake (in tables). The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

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.

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 (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.

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.

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.

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.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

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 areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

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.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

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, differences in 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 outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

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 accumulates over disintegrating rock.

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.

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 groundwater 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.

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.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

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.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

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 grained* (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 solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying 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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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 it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, 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.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands 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.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by melt water streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.