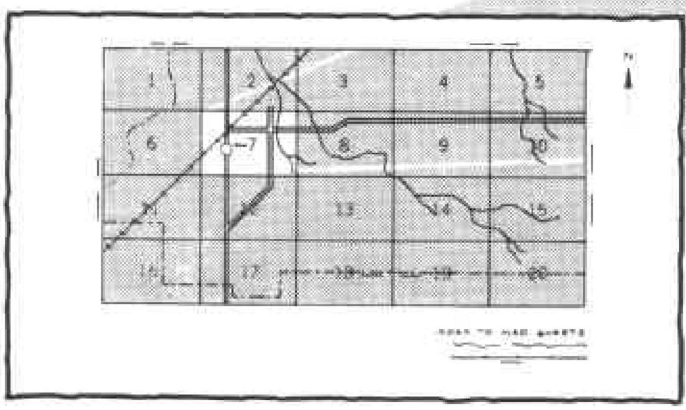
United States Department of Agriculture
Soil Conservation Service
in cooperation with the
Purdue University
Agricultural Experiment Station and the
Indiana Department of Natural Resources
Soil and Water Conservation Committee

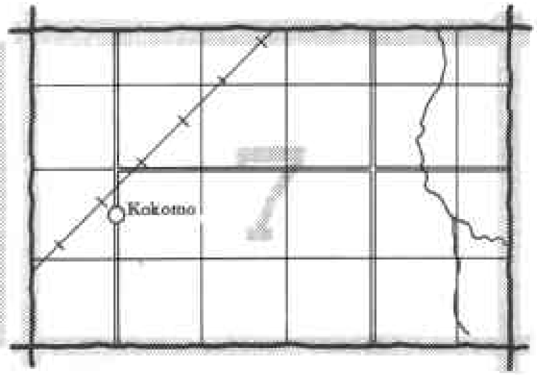
SOIL SURVEY OF

Starke County Indiana

HOW TO USE

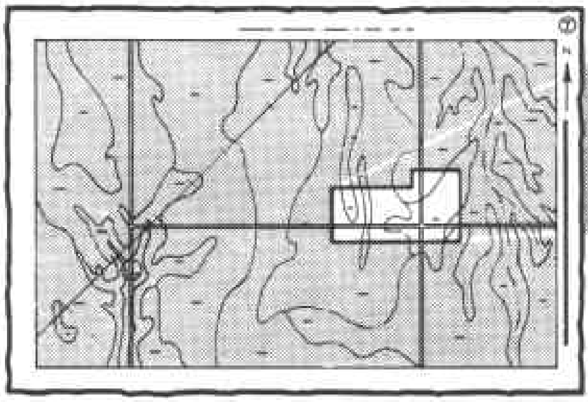
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

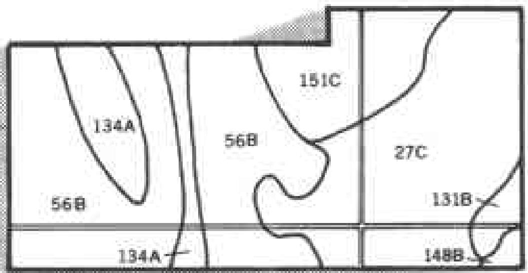




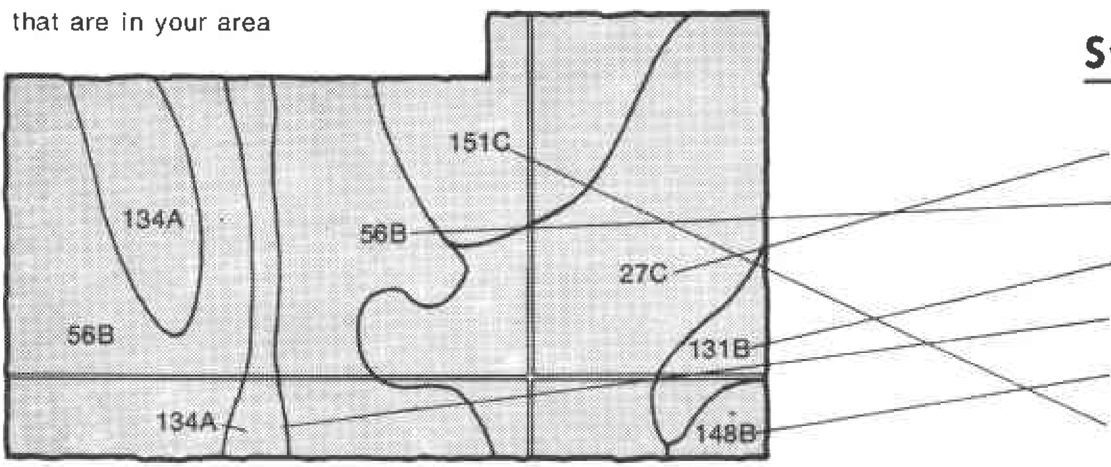
2. Note the number of the map sheet and turn to that sheet.

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





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

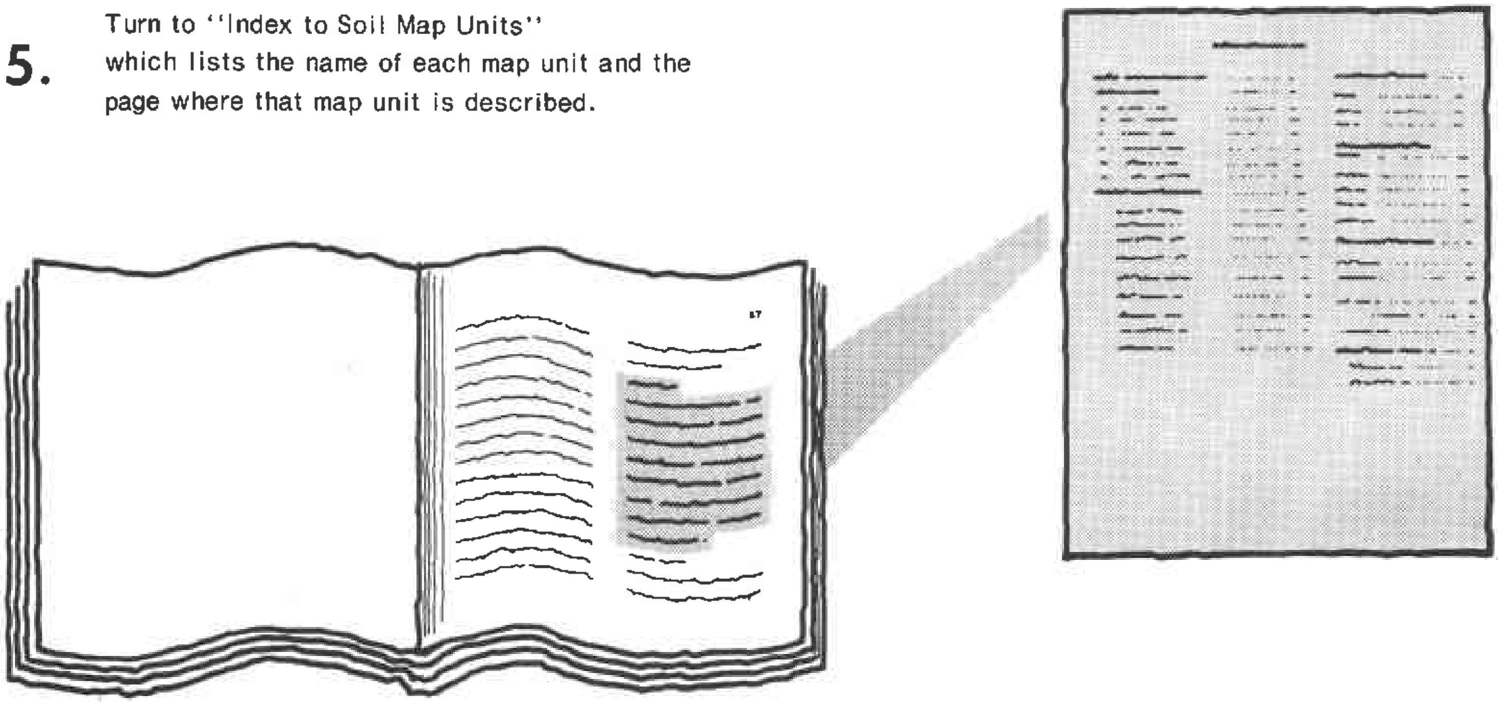


Symbols

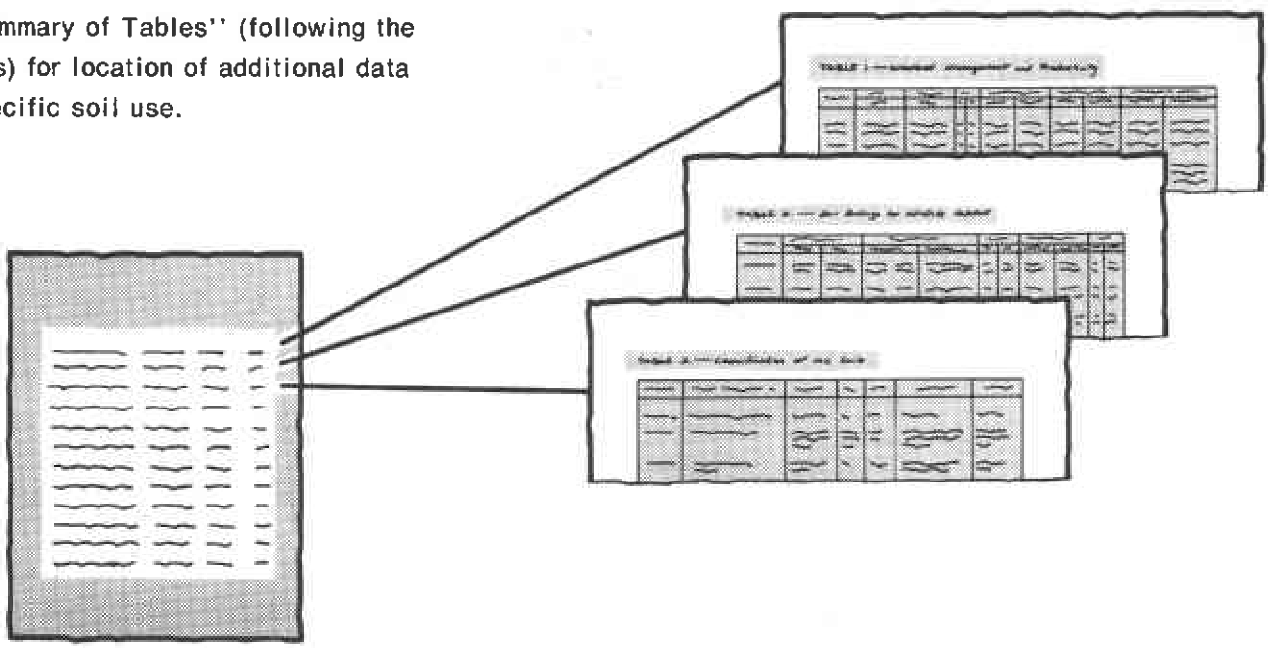
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

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



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



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for 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 1976-1979. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979. This survey was made cooperatively by the Soil Conservation Service; Purdue University Agricultural Experiment Station; and the Soil and Water Conservation Committee, Indiana Department of Natural Resources. It is part of the technical assistance furnished to the Starke County Soil and Water Conservation District. Financial assistance was made available by the Starke County Board of Commissioners.

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

Cover: Picnic area on Algansee soils along the Yellow River.

contents

soil series

Issued May 1982

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foreword

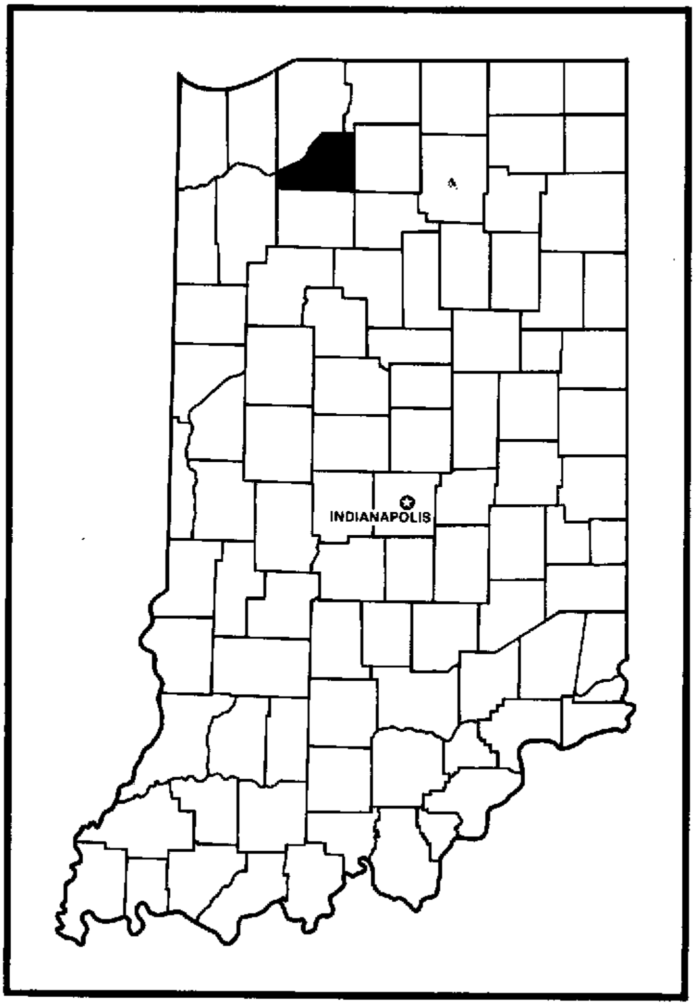
This soil survey contains information that can be used in land-planning programs in Starke County, Indiana. The first soil survey of Starke County was made in 1915 (*4*). This survey updates that first survey and provides additional information and larger maps that show the soils in greater detail. It contains predictions of soil behavior for selected land uses. This survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

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

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

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

Robert L. Eddleman
State Conservationist
Soil Conservation Service



Location of Starke County in Indiana.

soil survey of
Starke County, Indiana

By James R. Barnes, Soil Conservation Service

Fieldwork by James R. Barnes, Soil Conservation Service, and
Jerry W. Heltsley, Indiana Department of Natural Resources,
Soil and Water Conservation Committee

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the
Purdue University Agricultural Experiment Station and the
Indiana Department of Natural Resources,
Soil and Water Conservation Committee

Starke County is in northwestern Indiana. It has an area of 313 square miles, or 200,320 acres. Knox is the county seat and is in the central part of the county.

Farming is the main occupation in the county. About 60 percent of the county is cropland (*10*). Corn, soybeans, small grain, and hay are the principal crops. Specialty crops include mint, vegetables, strawberries, and blueberries. Raising livestock is an important farm enterprise. There are also several nurseries in the county. Most of the county has poor natural drainage and needs artificial drainage.

Grain is marketed mostly through local elevators. Livestock are marketed in neighboring counties.

Urban development is extending into most rural areas east of the Kankakee River flood plain. A large number of Starke County residents work in the steel mills in northwestern Indiana. Many residents are also employed in local industry.

general nature of the county

When the early missionaries, traders, and trappers came to the area that is now Starke County, they found it inhabited by the Potawatomi Indians. The first permanent settlement was made about 1840 near Ober. The county was organized by an act of the Legislature in 1844, but organization was not made effective until 1850.

The paragraphs that follow describe the features of Starke County that affect soil use. These include relief, water supply, climate, transportation facilities, and trends in population and land use.

relief

Starke County lies mainly on a flat plain dissected by the Yellow River and numerous drainageways. It is a nearly level and gently sloping outwash plain with intermittent steeper ridges. Nearly level flood plains are along the various rivers and major drainageways. Nearly level to moderately sloping lateral moraines are in the southeastern part of the county. Small to large, nearly level areas of organic (muck) soils are scattered throughout the county.

The elevation ranges from about 780 feet above sea level in the southeastern part to about 660 feet above sea level in the southwestern part (*6*).

water supply

Ground water is the main source of water in Starke County, and there is an adequate supply in most areas. The principal sources are sand and gravel deposits; sand and gravel deposits intermixed with glacial till; shale of Upper Devonian age; and limestone and dolomite of Middle Devonian age (*6,9*). The bedrock formations are 50 to as much as 200 feet below the surface (*6*).

climate

The National Climatic Center, Asheville, North Carolina, helped prepare this section.

Starke County is cold in winter but quite hot in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture by spring and minimizes drought during summer on some soils.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Plymouth, Indiana, in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 19 degrees. The lowest temperature on record, which occurred at Plymouth on January 28, 1963, is minus 24 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on June 20, 1953, is 109 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.

Rainfall is usually adequate for all crops in most of the county, but brief droughts occur nearly every year in the upland sandy soils that have low available water capacities. The total annual precipitation is more than 36 inches. Of this, 22 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 19 inches. The heaviest 1-day rainfall during the period of record was 4.37 inches at Plymouth on October 3, 1954. Thunderstorms occur on about 43 days each year, and most occur in summer.

Average seasonal snowfall is 36 inches. The greatest snow depth at any one time during the period of record was 19 inches. On an average of 23 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

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

Tornadoes and severe thunderstorms occur occasionally. These storms are usually local and of short duration and cause damage in a variable pattern.

transportation facilities

There are about 38 miles of federal highways and 70 miles of state highways that cross the county in all directions. In addition there are about 875 miles of county roads, most of them paved.

The Starke County Airport is located about 2 miles northwest of Knox. It is used by small private aircraft. Several small airstrips are located throughout the county.

Six railroad lines cross the county.

trends in population and land use

Starke County has a population of about 22,000 and a population density of about 70 persons per square mile. Population is expected to be over 33,000 by the year 2000 (*3*).

About 12 percent of the county is urban and residential land, and the remaining 88 percent is agricultural land and woodland. During the period of 1967 to 1974, cropland decreased from about 66 percent to about 60 percent of the county.

Most of the residential development in the county, excluding the areas within the cities and towns, is occurring southwest of Knox, east of Knox, northeast of North Judson, and around Bass and Koontz Lakes. Urban expansion is expected to continue at a moderate rate.

how this survey was made

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

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

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

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

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

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit, or association, 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.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the potential of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated farm crops, specialty crops, woodland, urban uses,* and *recreation areas*. Cultivated farm crops are those grown extensively in the survey area. Specialty crops are the vegetables and fruits that generally require intensive management. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas are those used for nature study and as wilderness.

soil descriptions

The names, descriptions, and delineations of soils on the general soil map of this county do not always agree or join fully with those of adjoining counties published at an earlier date. This difference is a result of changes in concepts of soil series in the application of the soil classification system. Other differences are caused by a different predominance of soils in map units made up of two or three series. Still other differences may be caused by the range in slope allowed within map units of adjoining surveys. In this county or in adjacent counties some map units are too small to be delineated.

1. Maumee-Gilford-Watseka association

Nearly level, very poorly drained and somewhat poorly drained soils formed in sandy deposits on outwash plains

This map unit consists of soils in broad flat areas that have few breaks in slope (fig. 1).

This unit covers about 37 percent of the county. It is about 33 percent Maumee soils, 14 percent Gilford soils, 14 percent Watseka soils, and 39 percent soils of minor extent.

Maumee and Gilford soils are very poorly drained and are in broad, low lying areas and in depressional areas. Maumee soils have a black, sand surface layer. The subsurface layer is very dark grayish brown sand. The underlying material is dark gray, dark grayish brown, grayish brown, and brown sand.

Gilford soils have a black, sandy loam surface layer and subsurface layer. The subsoil is dark gray and dark grayish brown sandy loam.

Watseka soils are somewhat poorly drained and are in broad, low lying areas; on low rises; and in depressional areas. They have very dark brown, loamy sand surface and subsurface layers. The subsoil is dark grayish brown and brown sand.

The minor soils are the somewhat poorly drained Morocco soils on slightly higher rises; the moderately well drained Brems soils and excessively drained and moderately well drained Plainfield soils on the highest ridges and knolls; the very poorly drained Newton and Maumee Variant soils in slightly lower areas; and the very poorly drained Adrian and Houghton soils in depressional areas.

This unit is used mainly for cultivated crops. Corn, soybeans, and small grain are the major crops. Most of the acreage has been drained. Some small areas are used for pasture. The potential is fair for cultivated crops, and the trend has been to continue growing cultivated crops. Ponding, wetness, droughtiness, soil blowing, and susceptibility to frost are the main limitations.

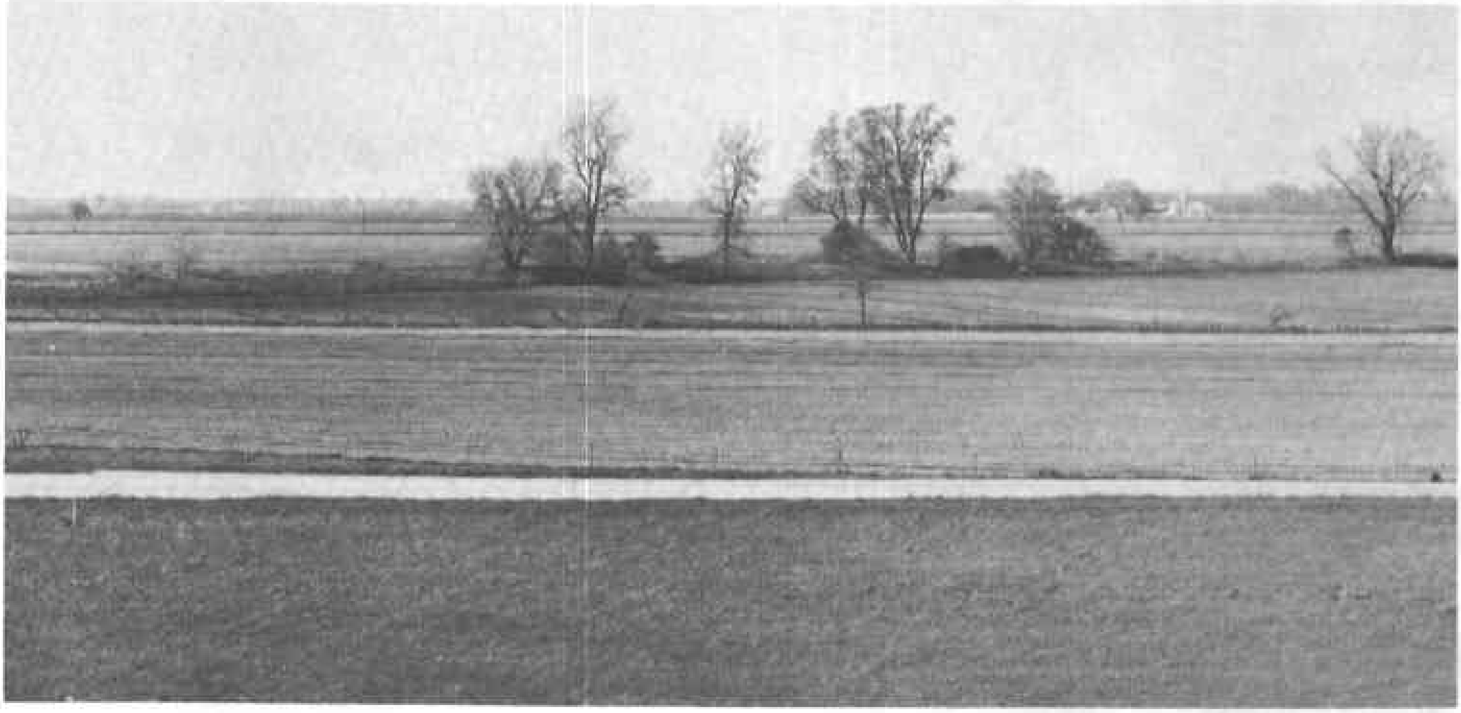


Figure 1.—Typical area of Maumee, Gilford, and Watseka soils.

This unit is generally unsuited to building sites, local roads and streets, and sanitary facilities. Wetness, ponding, poor filtering qualities, and frost action are the main limitations.

2. Houghton-Adrian association

Nearly level, very poorly drained soils formed in organic deposits on outwash plains, lake plains, and end moraines

This map unit consists of soils in broad, depressional areas. They are typically in the lowest part of the landscape.

This unit covers about 4 percent of the county. It is about 44 percent Houghton soils, 24 percent Adrian soils, and 32 percent soils of minor extent.

Houghton and Adrian soils are in broad, low lying and depressional areas. Houghton soils have organic material that is black in the upper part and very dark brown in the lower part. Adrian soils have black and very dark brown organic material in the upper part of the profile and gray and grayish brown sand in the lower part.

The minor soils are the somewhat poorly drained Watseka soils on low rises and the very poorly drained Toto and Edwards soils which have marl in the lower part of the profile and are similar to the Houghton and Adrian soils in position on the landscape.

This unit is used mainly for cultivated crops and specialty crops. Corn and mint are the major crops. Truck crops are also grown. Most of the acreage has been drained. The potential is fair for cultivated crops, and the trend has been to grow more corn and mint. Soil blowing, ponding, susceptibility to frost, wetness, and subsiding of the muck are the main limitations.

This unit is generally unsuited to building sites, local roads and streets, and sanitary facilities. Wetness, ponding, poor filtering qualities, frost action, and low strength are the main limitations.

3. Plainfield-Brems-Morocco association

Nearly level to strongly sloping, excessively drained to somewhat poorly drained soils formed in sandy deposits on outwash plains

This unit consists of soils in upland areas. The landscape is characterized by swale and swell topography with steeper slopes on the leeward side of ridges (fig. 2).

This unit covers about 38 percent of the county. It is about 42 percent Plainfield soils, 17 percent Brems soils, 16 percent Morocco soils, and 25 percent soils of minor extent.

Plainfield soils are nearly level to strongly sloping and are excessively drained and moderately well drained. They are in broad flat areas on low rises, on the higher knolls and ridges, on ridgetops, and on long side slopes. They have a dark grayish brown, sand surface layer and a strong brown and yellowish brown, sand subsoil.

Brems soils are nearly level, gently sloping, and moderately well drained. They are in broad flat areas, on low rises, and along side slopes. They have a very dark grayish brown, sand surface layer and a strong brown and yellowish brown, sand subsoil.

Morocco soils are nearly level and somewhat poorly drained. They are in the lower depressional areas and on the lower rises. They have a very dark grayish brown, loamy sand surface layer; a brown, sand subsurface layer; and a brownish yellow, sand subsoil.

The minor soils are the very poorly drained Maumee, Houghton, and Adrian soils in the lowest lying and depressional areas; the somewhat excessively drained Coloma soils and the well drained Ormas soils in landscape positions similar to the Plainfield soils; and the somewhat poorly drained Ormas Variant and Watseka soils in slightly lower areas. Ormas Variant soils and Ormas soils have a continuous sandy loam layer within 40 inches of the surface, and Watseka soils have a dark surface layer.

This unit is used mainly for cultivated crops or is in woodland. Corn, soybeans, and small grain are the major crops. Many small areas are used for hay, pasture, or urban development. This unit is generally unsuited to cultivated crops. Soil blowing and droughtiness are the main limitations. In recent years the trend has been towards nursery crops, hay, pasture, and urban development. Soil blowing, droughtiness, slope, and wetness in some areas are the main limitations.

This unit has fair potential for woodland. Droughtiness is the main limitation. The potential is fair for building sites, local roads and streets, and sanitary facilities. Slope, poor filtering qualities, wetness, and frost action in some areas are the main limitations.

4. Craigmile-Suman association

Nearly level, very poorly drained soils formed in loamy and silty sediment over sandy deposits on flood plains

This map unit consists of soils on bottom lands of major rivers. It is characterized by low relief and very little break in slope.

This unit covers about 4 percent of the county. It is about 43 percent Craigmile soils, 27 percent Suman soils, and 30 percent soils of minor extent.

Craigmile and Suman soils are in broad, low lying areas; in depressional areas; along drainageways; and in old stream channels. Craigmile soils have black, fine sandy loam surface and subsurface layers. The underlying material is grayish brown fine sandy loam and dark gray and very dark gray loamy sand in the upper part and brown sand in the lower part. Suman soils have a black, silt loam surface layer and a very dark brown, silt loam subsurface layer. They have a dark gray, silt loam and silty clay loam subsoil.

The minor soils are the very poorly drained Houghton and Toto soils, which contain muck. They are in

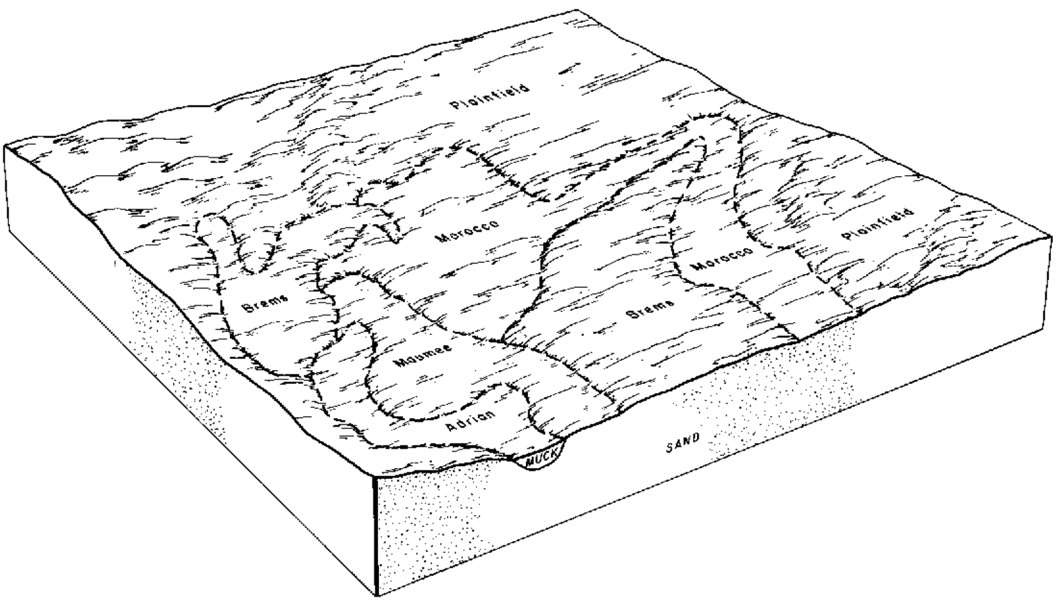


Figure 2.—General pattern of soils in the Plainfield-Brems-Morocco association.

landscape positions similar to the Craigmile and Suman soils.

This unit is used mainly for cultivated crops. Corn, soybeans, and small grain are the major crops. Most of the acreage has been drained. Many areas are used for wildlife habitat or are in woodland. The potential is fair for cultivated crops. The trend has been to continue growing cultivated crops in conjunction with establishing wildlife habitat. Flooding, wetness, ponding, and susceptibility to frost are the main limitations for cultivated crops.

This unit has fair potential for woodland. It is generally unsuited to building sites, local roads and streets, and sanitary facilities. Flooding, frost action, ponding, low strength, and wetness are the main limitations.

5. Algansee association

Nearly level and gently sloping, somewhat poorly drained soils formed in sandy and loamy sediment over sandy deposits on flood plains

This map unit consists of soils on bottom lands. It is characterized by old river channels, low bottom lands, and high bottom lands.

This unit covers about 3 percent of the county. It is about 51 percent Algansee soils and 49 percent soils of minor extent.

Algansee soils are nearly level and gently sloping and are in broad, lower lying areas; in old stream channels; along drainageways, and on lower rises. They have a dark brown, fine sandy loam surface layer and a dark brown, very fine sandy loam subsurface layer. The underlying material is dark brown, grayish brown, and brown fine sand and loamy fine sand.

The minor soils are the very poorly drained Craigmile and Prochaska soils in wetter depressional areas and the somewhat poorly drained Shoals Variant and Craigmile Variant soils that have more clay in the subsoil and are on slightly higher rises.

This unit is used mainly for cultivated crops. Corn, soybeans, and small grain are the major crops. Most of the acreage has been drained. Many small areas are used for hay or pasture or are in woodland. The potential is good for cultivated crops. The trend has been to continue growing cultivated crops. Soil blowing, droughtiness, flooding, and wetness are the main limitations.

The potential is fair for woodland. Wetness is the main limitation. This unit is generally unsuited to building sites, local roads and streets, and sanitary facilities. Flooding, frost action, poor filtering qualities, and wetness are the main limitations.

6. Craigmile association

Nearly level, very poorly drained soils formed in loamy, sandy, and silty sediment on flood plains

This map unit consists of soils on bottom lands. It is characterized by a very gradual swale and swell topography.

This unit covers about 4 percent of the county. It is about 63 percent Craigmile soils and 37 percent soils of minor extent.

Craigmile soils are very poorly drained and are in the lower lying and depressional areas and in old stream channels. They have black, fine sandy loam surface and subsurface layers. The underlying material is grayish brown fine sandy loam and dark gray and very dark gray loamy sand in the upper part and brown sand in the lower part.

The minor soils are the very poorly drained Prochaska and Suman soils in landscape positions similar to the Craigmile soils; the somewhat poorly drained Algansee and Algansee Variant soils in slightly higher areas; and the very poorly drained Adrian soils in the more depressional areas. Prochaska soils have less clay and Suman soils have more clay in the subsoil than do Craigmile soils. Adrian soils have a muck surface layer.

This unit is used mainly for cultivated crops. Corn, soybeans, and small grain are the major crops. Most of the acreage has been drained. Some small areas are in woodland. The potential is fair for cultivated crops. The trend has been to continue growing cultivated crops. Flooding, ponding, wetness, droughtiness, and soil blowing are the main limitations.

This unit is generally unsuited to building sites, local roads and streets, and sanitary facilities. Flooding, ponding, frost action, poor filtering qualities, and wetness are the main limitations.

7. Prochaska-Adrian association

Nearly level, very poorly drained soils formed in sandy alluvial deposits and in organic deposits on flood plains

This map unit consists of soils on bottom lands. It is characterized by low relief with very little break in slope. It is adjacent to sloping areas in the upland.

This unit covers about 7 percent of the county. It is about 37 percent Prochaska soils, 27 percent Adrian soils, and 36 percent soils of minor extent.

Prochaska soils are in the slightly higher lying areas. They have a black, loamy sand surface layer. The subsurface layer is very dark gray loamy sand. The subsoil is dark gray and black sand.

Adrian soils are in the lower depressional areas. The upper part of the profile is black and very dark brown organic material. The lower part is gray and grayish brown sand.

The minor soils are the very poorly drained Houghton and Toto soils in landscape positions similar to the Adrian soils; the very poorly drained Craigmile soils in the same position in the landscape as Prochaska soils; and the somewhat poorly drained Algansee soils in higher lying areas. Houghton soils are muck to a depth of 51 inches or more; Toto soils have marl underlying a muck surface layer; and Craigmile soils have more clay in the subsoil than do Prochaska soils.

This unit is used mainly for cultivated crops. Corn and soybeans are the major crops. Most of the acreage has been drained. Many areas are used for wildlife habitat or are in woodland. The potential is fair for cultivated crops. The trend has been to continue growing cultivated crops in conjunction with establishing wildlife habitat. Flooding, susceptibility to frost, subsiding of the muck, ponding, soil blowing, and droughtiness are the main limitations for cultivated crops.

The potential is fair for woodland. Ponding and flooding are the main limitations. This unit is generally unsuited to building sites, local roads and streets, and sanitary facilities. Flooding, ponding, frost action, poor filtering qualities, and low strength are the main limitations.

8. Markton-Metea-Crosier association

Nearly level and gently sloping, somewhat poorly drained and well drained soils formed in sandy deposits over loamy glacial till and in loamy glacial till on end moraines

This map unit consists of soils on upland areas. The landscape is very undulating with many swales, swells, and potholes (fig. 3). Steeper slopes are around the potholes and at the edge of the unit.

This unit covers about 3 percent of the county. It is about 47 percent Markton soils, 15 percent Metea soils, 10 percent Crosier soils, and 28 percent soils of minor extent.

Markton soils are somewhat poorly drained and are in broad, low lying areas; in depressional areas; and on low rises. They have a dark brown, sand surface layer. The subsoil is yellowish brown sand in the upper part and brown and light brownish gray loam in the lower part.

Metea soils are well drained and are on the higher rises. They have a dark brown, loamy sand surface layer. The subsoil is yellowish brown loamy sand in the upper part and yellowish brown fine sandy loam, sandy clay loam, and loam in the lower part.

Crosier soils are somewhat poorly drained and are in landscape positions similiar to the Markton soils. They have a dark brown, fine sandy loam surface layer. The subsoil is brown loam and yellowish brown clay loam.

The minor soils are the well drained Wawasee soils, which are in the same position in the landscape as Metea soils but do not have a sandy surface layer; the very poorly drained Edwards, Adrian, Napoleon, and Houghton soils in the lowest lying and depressional areas; and the excessively drained and moderately well drained Plainfield soils on higher ridges and knolls.

This unit is used mainly for cultivated crops. Corn, soybeans, and small grain are the major crops. Most of the acreage has been drained. Some small areas are used for hay or pasture or are in woodland. The potential is fair for cultivated crops. The trend has been to continue growing cultivated crops. Soil blowing, droughtiness, wetness, and erosion on steeper slopes are the main limitations.

The potential is fair for woodland. Droughtiness is the main limitation. This unit has poor potential for building

Figure 3.—Metea and Wawasee soils are on the ridges and Crosier soils are in the lower lying areas.

sites, local roads and streets, and sanitary facilities. Wetness, frost action, and low strength are the main limitations.

broad land use considerations

Deciding what land to use for urban development is an important issue in Starke County. Most of the development is in Center, Wayne, Washington, Oregon, and California Townships. The general soil map is helpful in planning the general outline of urban areas, but more detailed information should be used in selecting specific urban structures. As a general rule, those associations in Starke County that are the most suitable for urban development are not the most suitable units for growing cultivated crops.

There are extensive areas where soil properties make urban development not desirable or nearly prohibit it. The Maumee-Gilford-Watseka and Houghton-Adrian associations have severe wetness and ponding problems. The associations on flood plains also have wetness and flooding limitations. The Craigmile-Suman, Craigmile, and Prochaska-Adrian associations all have a seasonal high water table at or near the surface, and flooding is occasional or frequent. The Algansee association has a seasonal high water table ranging from 12 to 36 inches below the surface, and flooding is occasional or rare. The Morocco soils in the Plainfield-Brems-Morocco association are limited for urban development by poor filtering qualities and wetness. The Markton and Crosier soils in the Markton-Metea-Crosier association also have wetness limitations. Any development on these soils is risky and costly. Extensive drainage systems and properly designed sanitary facilities, buildings, and flood control structures would be required.

With properly designed alterations, a few of the following soils are suitable for urban use. The Plainfield soils are severely limited for septic tank absorption fields by poor filtering qualities, but they are suitable for building sites. The Brems soils are moderately to severely limited for urban development by wetness and poor filtering qualities. The Wawasee, Ormas, and Metea soils have few limitations for urban development. The Wawasee soils, however, are also well suited to cultivated crops.

The Maumee-Gilford-Watseka association, which covers more than a third of the county, is suitable for cultivated crops. Adequate drainage can overcome the wetness and ponding limitations. Most of the remaining associations in the county are suitable for cultivated crops. Wetness, ponding, flooding, and droughtiness are the main limitations. With proper management practices and selection of crops, however, these associations will produce fair to good yields.

Specialty crops are an important source of income in some parts of Starke County. The Houghton-Adrian association is well suited to mint and truck crops. Adequate drainage is necessary for optimum production and will also help the soils warm up earlier in the spring. The Plainfield-Brems-Morocco and Maumee-Gilford-Watseka associations have soils suitable for tree nurseries, blueberries, and strawberries. Some of the soils in the Markton-Metea-Crosier association are also suitable for certain truck crops.

All of the soils in Starke County are suitable for woodland. Limitations and hazards such as wetness, ponding, flooding, and droughtiness affect equipment, seedling mortality, windthrow hazard, and plant competition. Proper management practices and planting species best suited to the soil will provide optimum growth and maximum economic returns. Most of the soils in the Plainfield-Brems-Morocco association are ideal for certain species of pine and spruce for Christmas tree production and windbreaks. Some of the soils in the lower lying areas of the bottom land associations are suitable for certain water-tolerant species with deep root systems. Some of the soils in the Markton-Metea-Crosier association are well suited to various species of commercially valuable trees.

Most of the associations are poorly suited to parks and other intensive recreation areas. Wetness, ponding, and flooding are the major limitations and hazards. Adequate drainage can control wetness to some extent. The Plainfield-Brems-Morocco, Algansee, and Markton-Metea-Crosier associations are suitable for intensive recreation areas. The main limitations are wetness, flooding, and sandy conditions. These soils, however, will not be able to handle heavy use without serious damage to the vegetation, which will eventually lead to other problems. All of the associations are suitable for extensive recreation areas. They all provide some habitat for many important species of wildlife, and nature study areas would be excellent in most of the associations. The bottom land associations especially are excellent for wetland wildlife habitat and wilderness areas. With proper game management these areas will provide optimum habitat.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Plainfield sand, 8 to 15 percent slopes, is one of several phases in the Plainfield series.

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

A *soil complex* consists of two or more soils 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. Ormas Variant-Morocco loamy sands, 0 to 2 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. These are too small to be shown and are identified by a special symbol on the soil maps.

Table 5 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

Ad—Adrian muck, drained. This nearly level, very poorly drained soil is often ponded by surface runoff from adjacent soils. It is in broad, low lying areas; in depressional areas; and along drainageways. Mapped areas are usually irregular in shape, but some are round. They range from 5 to about 200 acres in size. The dominant size is about 40 acres.

In a typical profile the surface layer is black muck about 8 inches thick. Organic material extends to a depth of about 36 inches. The upper part is black, friable muck; the lower part is very dark brown, friable muck. The underlying material, to a depth of about 60 inches, is gray sand in the upper part and grayish brown sand in the lower part. In some small areas the underlying material is browner. In many small areas this soil is underlain with marl, or else the muck is more than 50 inches deep. There are many small areas where this soil has 8 to 16 inches of muck over sand.

Included with this soil in mapping are a few small areas of very poorly drained Maumee soils on slightly higher knolls. A few small areas of more acid soils and very poorly drained soils with muck over loam are throughout the unit. A few areas of this soil are undrained. These inclusions make up about 14 percent of the unit.

The permeability of this Adrian soil is moderately slow to moderately rapid in the upper part and rapid in the lower part. The available water capacity is very high. The organic matter content of the surface layer is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, mint, and truck crops are the major crops.

This soil is suitable for corn, mint, blueberries, and truck crops. Soil blowing, ponding, and early or late seasonal frost are hazards. (fig. 4). Overdrainage may result in droughtiness. Limitations are the soil warming up slowly in the spring, possibility of the muck burning, and subsiding of the muck when drained. Ponded areas hinder the use of equipment and machinery bogs down in this soil when it is wet. Management of the water table determines the rate of oxidation. Overdrainage will increase the rate. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, a combination of these practices, or permanent vegetation. Delaying cultivation in spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. When drained, this soil will warm up earlier in the spring.

This soil is well suited to grasses and legumes for hay, but is poorly suited to pasture. Soil blowing and ponding are hazards. Frost heaving is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil is severely limited for building sites and sanitary facilities by ponding, low strength, and poor filtering qualities of the soil. It is generally unsuited to these uses. This soil is severely limited for local roads by ponding, low strength, and frost action. Removing the unstable material and hauling in suitable fill will help control frost action and help to support vehicular traffic. Road ditches will lower the water table and reduce frost action.

This soil is in capability subclass IVw; woodland suitability subclass 4w.

Af—Adrian muck, frequently flooded. This nearly level, very poorly drained soil is frequently flooded for long periods. It is in broad, low lying areas; in depressional areas; and along drainageways. Mapped areas are irregular in shape and range from 80 to about 600 acres in size. The dominant size is about 80 acres.

In a typical profile the surface layer is black muck about 10 inches thick. Organic material extends to a depth of about 34 inches. The upper part is very dark brown, friable muck; the lower part is very dark grayish brown, friable muck. The underlying material, to a depth of about 60 inches, is grayish brown sand in the upper part and gray sand in the lower part. In many small areas the underlying material is blacker. There are thin layers of mineral material in the organic layer in some pedons. In a few areas this soil has 8 to 16 inches of muck over sand. In some areas the underlying material is browner.

Included with this soil in mapping are a few small areas of very poorly drained Craigmile and Prochaska soils on slightly higher knolls. A few small areas of very poorly drained soils with muck over stratified sand and muck are throughout the unit. These inclusions make up about 8 percent of the unit.

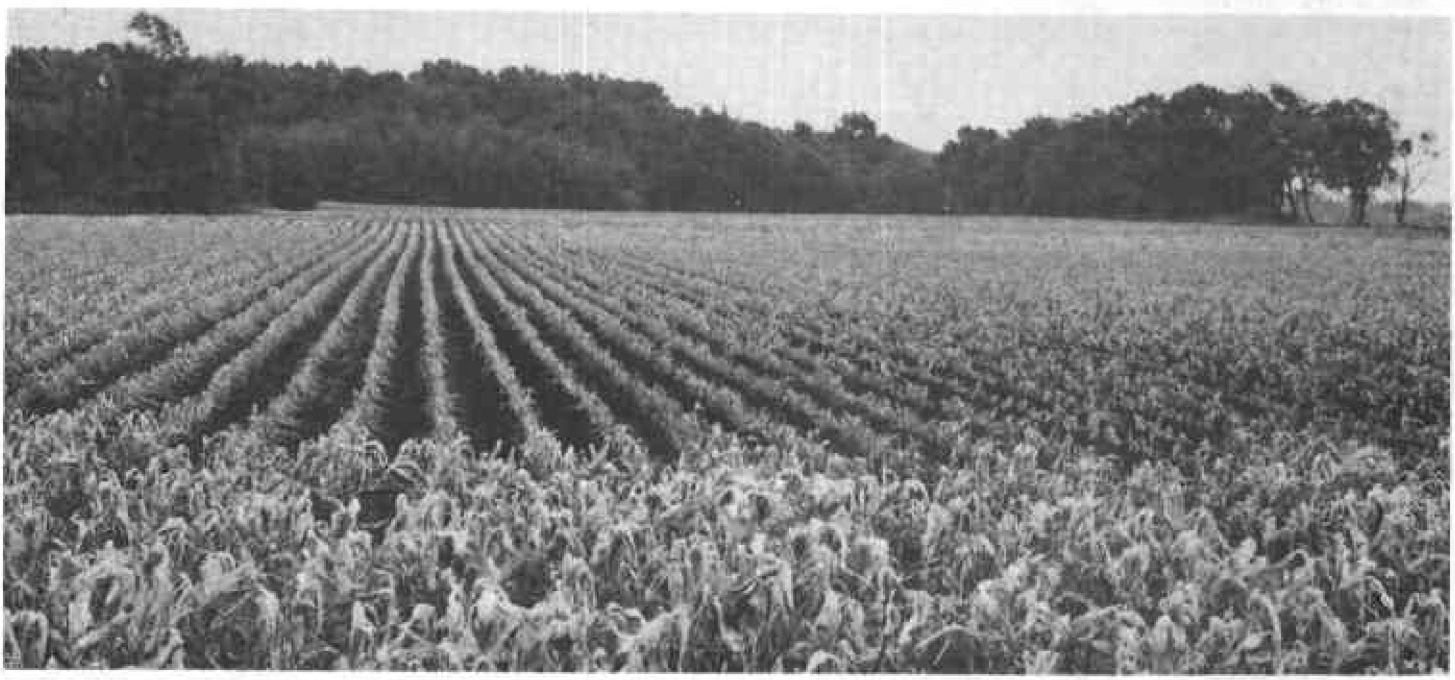


Figure 4.—Corn on Adrian soils is subject to severe frost damage in spring.

The permeability of this Adrian soil is moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part. The available water capacity is very high. The organic matter content of the surface layer is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn is the major crop. Many areas are used for wildlife habitat, and some are in woodland.

This soil is suitable for corn, mint, blueberries, and truck crops. Soil blowing, flooding, ponding, and early or late seasonal frost are hazards. Overdrainage may result in droughtiness. Limitations are the soil warming up slowly in the spring, possibility of the muck burning, and subsiding of the muck when drained. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Management of the water table determines the rate of oxidation. Overdrainage will increase the rate. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, a combination of these practices, or permanent vegetation. Levees will help control some flooding. Delaying cultivation in spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. When drained, this soil will warm up earlier in the spring.

This soil is well suited to grasses and legumes for hay, but is poorly suited to pasture. Soil blowing, flooding, and ponding are hazards. Frost heaving is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil is suitable for trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. The possibility of the muck burning is a limitation. Some of the equipment limitations can be avoided by harvesting and logging during dry periods or the winter months. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Water-tolerant trees with deep root systems are best suited to timber stands. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of flooding, ponding, and low strength. This soil is severely limited for local roads for the same reasons. Levees will help control flooding. Removing the unstable material and hauling in suitable fill will help to support vehicular traffic. Road ditches will lower the water table.

This soil is in capability subclass IVw and woodland suitability subclass 3w.

An—Algansee fine sandy loam, occasionally flooded. This nearly level and gently sloping, somewhat poorly drained soil is occasionally flooded for very brief periods. It is in broad, low lying areas; in old stream channels; along drainageways; and on low rises on flood plains. Mapped areas are irregular in shape and range from 5 to about 250 acres in size. The dominant size is about 70 acres.

In a typical profile the surface layer is dark brown fine sandy loam about 9 inches thick. The subsurface layer is dark brown, mottled very fine sandy loam about 3 inches thick. The underlying material, to a depth of about 60 inches, is dark brown, grayish brown, or brown, mottled fine sand and loamy fine sand. In many small areas there is gravelly sand in the underlying material. In some areas this soil has a loamy sand, sand, or silt loam surface layer. In a few areas the underlying material is browner.

Included with this soil in mapping are small areas of somewhat poorly drained Algansee Variant soils in slightly lower areas. There are small areas of very poorly drained Prochaska soils in wetter depressional areas. Many small areas of somewhat poorly drained Craigmile Variant and Shoals Variant soils are on slightly higher ridges. These inclusions make up about 14 percent of the unit.

The permeability of this Algansee soil is rapid. The available water capacity is low. The organic matter content of the surface layer is moderate. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 2 feet.

Most areas of this soil are used for pasture and cultivated crops. Corn and soybeans are the major crops. Many areas are in woodland.

This soil is suitable for corn, soybeans, and small grain. Soil blowing and flooding are hazards. Wetness hinders normal root growth, but during the summer months insufficient moisture, which results in droughtiness, is a limitation. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Levees will help control some flooding. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and flooding are hazards. Both wetness and, during the summer months, insufficient moisture resulting in droughtiness are limitations. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and results in soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of flooding, wetness, and poor filtering qualities. This soil is severely limited for local roads by the flooding. Levees will help control some flooding. Hauling in suitable fill material and constructing roads on elevated areas will also help.

This soil is in capability subclass IIIw and woodland suitability subclass 3s.

As—Algansee Variant sand, occasionally flooded. This nearly level, somewhat poorly drained soil is occasionally flooded for very brief to brief periods. It is in broad, low lying areas; along drainageways; and on low rises on flood plains. Mapped areas are irregular in shape and range in size from 5 to about 260 acres. The dominant size is about 10 acres.

In a typical profile the surface layer is dark brown sand about 9 inches thick. The underlying material, from a depth of about 9 to 29 inches, is yellowish brown, mottled sand. The underlying material, from a depth of about 29 to 40 inches, is very dark gray sandy loam. Below this, to a depth of about 60 inches, the underlying material is dark gray, mottled sandy loam in the upper part and gray, mottled silt loam in the lower part. In some areas this soil has less than 20 inches or more than 40 inches of sandy material in the upper part of the profile. In a few areas the surface layer is silt loam or fine sandy loam.

Included with this soil in mapping are some small areas of somewhat poorly drained Algansee soils on slightly higher knolls. Small areas of very poorly drained Craigmile and Suman soils are in wetter depressional areas. Also included are many small, lower lying areas where this soil is grayer in the upper part of the profile. These inclusions make up about 12 percent of the unit.

The permeability of this Algansee Variant soil is rapid in the upper part of the profile and moderately rapid in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is low. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 2 feet.

Most areas of this soil are used for cultivated crops. Corn and soybeans are the major crops. Some small areas are in woodland.

This soil is suitable for corn, soybeans, and small grain. Soil blowing and flooding are hazards. Wetness hinders normal root growth, but during the summer months, insufficient moisture, which results in droughtiness, is a limitation. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Levees will help control some flooding. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and flooding are hazards. Wetness and, during the summer months, insufficient moisture resulting in droughtiness are limitations. Overgrazing and grazing during wet periods are the major management concerns.

This soil is suitable for trees. Seedling mortality is severe. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited for these uses because of flooding and wetness. This soil is severely limited for local roads by flooding and frost action. Levees will help control some flooding. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches will also help overcome these limitations.

This soil is in capability subclass IIIw and woodland suitability subclass 3s.

BeA—Brems sand, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is in broad, flat areas; on low rises; and along side slopes. Mapped areas are usually irregular in shape, but some are long and narrow. They range from 3 to about 200 acres in size. The dominant size is about 50 acres.

In a typical profile the surface layer is very dark grayish brown sand about 8 inches thick. The subsoil is about 36 inches thick. It is strong brown and yellowish brown, mottled, very friable and loose sand. The underlying material, to a depth of about 60 inches, is light yellowish brown and pale brown, mottled sand. In some small areas this soil has more fine sand in the subsoil, grayer mottles in the lower part of the subsoil, or a thicker and blacker surface layer. In some areas this soil has small amounts of pebbles and shale fragments throughout the profile or has thin lenses of loamy sand in the lower part.

Included with this soil in mapping are some small areas of very poorly drained Maumee soils in wetter depressional areas. Some small areas of somewhat poorly drained Morocco soils are in lower areas. Many small areas of excessively drained Plainfield soils and moderately well drained Plainfield, wet substratum, soils are on the higher ridges and knolls. These inclusions make up about 14 percent of the unit.

The permeability of this Brems soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is very slow. The seasonal high water table fluctuates between depths of 2 and 4 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Many small areas are in woodland or are used for hay or pasture. Some areas are used for urban development.

This soil is poorly suited to corn, soybeans, and small grain. Soil blowing is a hazard. Insufficient moisture during the summer months causes this soil to become droughty. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Irrigation can reduce droughtiness. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage help to maintain and improve tilth, moisture content, and organic matter content of this soil.

This soil is suitable for grasses and legumes for hay or pasture. Soil blowing is a hazard. Insufficient moisture during the summer months causes this soil to become droughty. Overgrazing reduces plant density and hardiness and results in soil blowing. Proper stocking, timely deferment of grazing, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe, and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

Wetness is a moderate limitation for dwellings without basements and a severe limitation for dwellings with basements. An adequate drainage system with storm sewers is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. This soil is moderately limited for local roads and streets by the wetness. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches will help overcome this limitation. This soil is severely limited for septic tank absorption fields by wetness and poor filtering qualities of the soil. The rapid permeability could result in seepage of the effluent into ground water supplies. Hauling in enough suitable fill material, installing deep wells, using a mound system, enlarging the size of the filter fields, or connecting the sanitary facilities to commercial sewer systems are some alternatives to this problem.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

ChB—Coloma sand, 0 to 6 percent slopes. This nearly level and gently sloping, somewhat excessively drained soil is in broad, flat areas and on low rises. Mapped areas are usually irregular in shape, but some are long and narrow. They range in size from 5 to about 400 acres. The dominant size is about 80 acres.

In a typical profile the surface layer is dark brown sand about 10 inches thick. The subsurface layer is about 50 inches thick. The upper part of the subsurface layer is yellowish brown sand; the lower part is light yellowish brown sand with dark brown bands of loamy sand. In some areas there are no loamy sand bands, and in a few of these areas there are brown mottles in the lower part of the profile. The depth to the uppermost loamy sand band is greater than 60 inches in a few areas.

Included with this soil in mapping are some small areas of moderately well drained Brems soils and somewhat poorly drained Morocco soils in the lower lying areas. A few small areas of steeper soils are throughout the unit. These inclusions make up about 6 percent of the unit.

The permeability of this Coloma soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is slow.

Most areas of this soil are used for cultivated crops. Corn and soybeans are the major crops. Many small areas are used for woodland, hay, or pasture.

This soil is poorly suited to corn, soybeans, and small grain. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Erosion can be controlled by terraces, diversions, crop residue management, contour strips, stripcropping, cover crops, grassed waterways, conservation tillage, crop rotation, grade stabilization structures, or a combination of these practices. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage can help to maintain and improve tilth, moisture content, and organic matter content of this soil.

This soil is suitable for grasses and legumes for hay or pasture. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. The erosion and soil blowing can be caused by overgrazing, which reduces plant density and hardiness. Proper stocking, strip grazing, timely deferment of grazing, and frequent grazing rotations during the summer months will help maintain good plant density and hardiness, reduce erosion and soil blowing, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality and plant competition are moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for building sites and local roads and streets. It is severely limited for septic tank absorption fields by poor filtering qualities of the soil. The rapid permeability could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to help overcome the poor filtering problem. Enlarging the filter field, installing deep wells, or connecting the sanitary facilities to commercial sewer systems should also be considered.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

Co—Craigmile fine sandy loam, frequently flooded. This nearly level, very poorly drained soil is frequently flooded for brief to long periods. It is in broad, low lying areas; in depressional areas; along drainageways; and in old stream channels. Mapped areas are irregular in shape and range in size from 5 to about 300 acres. The dominant size is about 80 acres.

In a typical profile the surface layer is black fine sandy loam about 9 inches thick. The subsurface layer is black, mottled fine sandy loam about 3 inches thick. The underlying material, from a depth of about 12 to 25 inches, is grayish brown, mottled fine sandy loam. The underlying material, from a depth of about 25 to 48 inches, is dark gray, mottled loamy sand in the upper part and very dark gray, mottled loamy sand in the lower part. Below this, to a depth of about 60 inches, the underlying material is brown, mottled sand. In some small areas this soil has more sand and less clay in the upper part of the profile. In many areas the surface layer is less than 10 inches thick, and in some of these areas it is browner. The lower part of the profile is sandy loam or loam in a few areas.

Included with this soil in mapping are some small areas of very poorly drained Adrian soils and frequently flooded soils in more depressional areas. A few areas of somewhat poorly drained Algansee and Algansee Variant soils are on small ridges and knolls. Also included are many small, slightly lower areas of very poorly drained Suman soils. These inclusions make up about 10 percent of the unit.

The permeability of this Craigmile soil is moderately rapid in the upper part of the profile and rapid in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Many areas are used for wildlife habitat or are in woodland.

This soil is suitable for corn, soybeans, and small grain. Flooding, ponding, and frost are hazards. The soil warming up slowly in the spring is a limitation. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Levees will help control some flooding. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will help the soil warm up earlier in the spring. Overdrainage, however, can result in droughtiness. Conservation practices such as crop residue management, green manure crops, and conservation tillage help to maintain and improve tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Flooding and ponding are hazards. Overgrazing and grazing during wet periods are the major management concerns.

This soil is suitable for trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. Some of the equipment limitations can be avoided by harvesting and logging during dry periods or winter months. Planting more trees than necessary will compensate for the seedling mortality, but thinning may be required later. Water-tolerant species with deep root systems are best suited to timber stands. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited for these uses because of flooding, ponding, and poor filtering qualities of the soil. This soil is severely limited for local roads by flooding, ponding, and frost action. Levees will control some flooding. Hauling in suitable fill material and constructing road ditches with culverts will help overcome all of these limitations.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

Cp—Craigmile Variant fine sandy loam, rarely flooded. This nearly level, somewhat poorly drained soil is rarely flooded. It is in broad, low lying areas; on low rises on flood plains; and along drainageways. Mapped areas are irregular in shape and range in size from 5 to about 400 acres. The dominant size is about 80 acres.

In a typical profile the surface layer is very dark gray fine sandy loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is gray, mottled, friable fine sandy loam; the middle part is brown, mottled, friable fine sandy loam; and the lower part is brown, mottled, firm loamy fine sand. The underlying material, below a depth of about 38 to 49 inches, is pale brown, mottled fine sand. Below this, to a depth of about 60 inches, it is yellowish brown, mottled sand. In many small areas this soil has more clay in the subsoil. In some areas the depth to the underlying material is less than 30 inches or more than 50 inches. The subsoil is browner in a few areas and dominantly gray in some. In some areas there are soils stratified with loam and sand throughout the profile.

Included with this soil in mapping are many small areas of somewhat poorly drained Algansee soils at slightly lower elevations and in old stream channels. Some small areas of very poorly drained Craigmile and Suman soils are in wetter depressions. These inclusions make up about 10 percent of the unit.

The permeability of this Craigmile soil is moderately rapid in the upper part of the profile and rapid in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is moderate. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas are used for hay or pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Flooding is a hazard, and wetness is a limitation. Levees will control some flooding. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Flooding is a hazard, and wetness is a limitation. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods and strip grazing during the summer months will help reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Plant competition is moderate, but seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited for these uses because of flooding, wetness, and poor filtering qualities of the soil. This soil is severely limited for local roads by frost action. Road ditches will lower the water table and reduce frost action. Hauling in suitable fill material will also reduce frost action.

This soil is in capability subclass IIw and woodland suitability subclass 3w.

CrA—Crosier fine sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is in broad, low lying areas in the uplands; in depressional areas; and on low rises. Mapped areas are irregular in shape and range from 5 to about 180 acres in size. The dominant size is about 20 acres.

In a typical profile the surface layer is dark brown fine sandy loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part of the subsoil is brown, mottled, firm loam; the lower part is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of about 60 inches, is yellowish brown, mottled loam. In small areas of this soil there is less clay in the upper part of the subsoil. In a few areas the underlying material is gravelly loam, gravelly sandy loam, or silt loam. In some small areas the underlying material is less than 24 inches or more than 40 inches deep. The upper part of the profile is browner in a few areas.

Included with this soil in mapping are some small, lower areas of very poorly drained Gilford soils and soils that have a thicker, darker surface layer and a grayer subsoil. Many small areas of somewhat poorly drained Markton soils are on slightly higher areas. These Markton soils are sandy to a depth of more than 20 inches. A few areas of steeper soils are throughout the unit. These inclusions make up about 12 percent of the unit.

The permeability of this Crosier soil is moderately slow. The available water capacity is high. The organic matter content of the surface layer is moderate. Runoff is slow or medium. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas are used for hay or pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Erosion and runoff on steeper slopes are hazards. Wetness is a limitation. Erosion and runoff can be controlled by terraces, diversions, crop residue management, contour strips, stripcropping, cover crops, grassed waterways, conservation tillage, crop rotation, grade stabilization structures, or a combination of these practices. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Conservation tillage that leaves all or part of the crop residue on the surface, green manure crops, and cover crops help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion on steeper slopes is a hazard, and wetness is a limitation. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes erosion. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes excessive runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months will help control erosion, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Plant competition is moderate. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is severely limited for building sites by wetness. An adequate foundation drainage system with storm sewers is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. Backfilling the foundation trench with suitable coarse material is helpful. This soil is severely limited for local roads and streets by frost action and low strength. Road ditches will lower the water table and help reduce frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help to support vehicular traffic and reduce frost action. This soil is severely limited for septic tank absorption fields by wetness and moderately slow permeability. Connecting sanitary facilities to a commercial sewer system, if available, should be considered. It might be possible to select a nearby site on a better suited soil.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Ed—Edwards muck, drained. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are usually irregular in shape, but some are round. They range from 5 to 100 acres in size. The dominant size is about 10 acres.

In a typical profile the surface layer is black muck about 9 inches thick. Organic material extends to a depth of about 22 inches. It is very dark brown, friable muck. The underlying material, to a depth of about 60 inches, is gray marl in the upper part and grayish brown marl in the lower part. In some areas there is 8 to 16 inches of muck over the marl. Many small areas of this soil are underlain with sand at a depth of 16 to 50 inches; some areas are underlain by both marl and sand. In other small areas the muck extends to a depth of more than 50 inches.

Included with this soil in mapping are small areas of very poorly drained Maumee soils on low ridges and knolls. A few areas are undrained. These inclusions make up about 14 percent of the unit.

The permeability of this Edwards soil is moderately slow to moderately rapid. The available water capacity is very high. The organic matter content of the surface layer is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas are used for cultivated crops. Corn, mint, and truck crops are the major crops.

This soil is suitable for corn, mint, and truck crops. Soil blowing, ponding, and frost are hazards. Limitations are the soil warming up slowly in the spring, possibility of the muck burning, and subsiding of the muck when drained. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Management of the water table determines the rate of oxidation. Overdrainage will increase the rate. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, a combination of these practices, or permanent vegetation. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Overdrainage, however, can result in droughtiness. These practices will help the soil warm up earlier in the spring.

This soil is well suited to grasses and legumes for hay and is poorly suited to pasture. Soil blowing and ponding are hazards. Frost heaving is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited for these uses because of ponding, low strength, and moderately slow permeability. This soil is severely limited for local roads by ponding, low strength, and frost action. Removing the unstable material and hauling in suitable fill will help overcome these limitations. Road ditches and culverts will lower the water table and help reduce frost action.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

Gf—Gilford sandy loam. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and in depressions. Mapped areas are irregular in shape and range in size from 3 to over 500 acres. The dominant size is about 80 acres.

In a typical profile the surface layer is black sandy loam about 10 inches thick. The subsurface layer is black, mottled sandy loam about 5 inches thick. The subsoil is about 19 inches thick. It is dark gray and dark grayish brown, mottled, friable sandy loam. The underlying material, to a depth of 60 inches, is dark grayish brown, pale brown, and brown loamy sand and sand. In some small areas there is more clay in the subsoil. The surface is less than 10 inches thick in some areas. In some areas the underlying material is at a depth of less than 20 inches or more than 40 inches. The surface layer in a few small areas is loamy sand or mucky sandy loam. In many areas there is more sand and less clay in the profile. The underlying material is coarse sand in a few areas.

Included with this soil in mapping are some small areas of somewhat poorly drained Morocco soils on small ridges and knolls. A few areas of somewhat poorly drained Watseka soils are on slightly higher areas. Many small areas of soils that are browner in the upper part of the subsoil are on higher areas. These inclusions make up about 9 percent of the unit.

The permeability of this Gilford soil is moderately rapid in the upper part of the profile and rapid in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas are used for pasture.

This soil is well suited to corn, soybeans, and small grain. Ponding and frost are hazards (fig. 5). The soil warming up slowly in the spring is a limitation. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Overdrainage, however, can result in droughtiness. These practices will help the soil warm up earlier in the spring. Conservation tillage that leaves all or part of the crop residue on the surface and green manure crops help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Ponding is a hazard. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness. Grazing during wet periods causes surface compaction, which results in poor soil tilth, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months will help reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil has severe limitations for building sites and

Figure 5.—Ponding on Gilford soils can hinder the use of equipment and delay field operations.

sanitary facilities. It is generally unsuited for this use because of ponding and poor filtering qualities of the soil.

This soil is severely limited for local roads by ponding and frost action. Hauling in suitable fill, constructing roads on well-compacted elevated areas and road ditches with culverts will help overcome these limitations.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

Ho—Houghton muck, drained. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are usually irregular in shape, but some are round. They range from 5 to about 400 acres in size. The dominant size is about 80 acres.

In a typical profile the surface layer is black muck about 10 inches thick. Organic material extends to a depth of about 60 inches. The upper part is black, friable muck; the middle part is very dark brown, friable muck; and the lower part is very dark brown, very friable muck. In many small areas there are layers of fibers that are not as well decomposed. In many small areas sand, marl, or a combination of sand and marl is within 16 to 50 inches of the surface.

Included with this soil in mapping are a few small areas of very poorly drained Maumee soils on slightly higher knolls. A few areas are undrained. These inclusions make up about 7 percent of the unit.

The permeability of this Houghton soil is moderately slow to moderately rapid. The available water capacity is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, mint, and truck crops are the major crops.

This soil is suitable for corn, mint, and truck crops. Soil blowing, ponding, and frost are hazards. Limitations are the soil warming up slowly in the spring, possibility of the muck burning, and the muck subsiding when drained. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Management of the water table determines the rate of oxidation. Overdrainage will increase the rate. This soil is very unstable and caution in the use of heavy equipment is advised, especially near drainage ditches. Soil blowing can be controlled by windbreaks, conservation tillage that leaves all or part of the crop residues on the surface, stripcropping, a combination of these practices, or permanent vegetation. Delaying cultivation in spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Overdrainage, however, can result in droughtiness. These practices will help the soil warm up earlier in the spring.

This soil is well suited to grasses and legumes for hay and is poorly suited to pasture. Soil blowing and ponding are hazards. Frost heaving is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of ponding, low strength, and moderately slow permeability. This soil is severely limited for local roads by ponding, low strength, and frost action. Removing the unstable material and hauling in suitable fill will help overcome these limitations. Road ditches and culverts will lower the water table and help reduce frost action.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

MdA—Markton sand, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is in broad, low lying areas in the uplands; in depressional areas; and on low rises. Mapped areas are irregular in shape and range from 3 to about 200 acres in size. The dominant size is about 10 acres.

In a typical profile the surface layer is dark brown sand about 11 inches thick. The subsoil is about 25 inches thick. The upper part of the subsoil is yellowish brown, mottled, very friable sand; the lower part is brown and light brownish gray, mottled, friable loam. The underlying material, from a depth of about 36 to 55 inches, is light brownish gray, mottled loam in the upper part and gray, mottled loam in the lower part. Below this, to a depth of about 60 inches, the underlying material is brown, mottled loam. In some areas this soil has less than 20 inches of sandy material in the upper part. In many small areas this soil has more than 40 inches of sandy material in the upper part, and in many of these areas the upper part of the subsoil is browner. In a few areas the underlying material is sandy loam or gravelly sandy loam. In some small areas this soil is browner in the upper part of the profile.

Included with this soil in mapping are some small areas of somewhat poorly drained Crosier soils in slightly lower areas. Crosier soils have less than 20 inches of sand in the surface layer. Many small areas of very poorly drained Gilford soils and soils that have a thicker, darker surface layer and a grayer subsoil are in lower areas. Many small areas of somewhat poorly drained Morocco soils are throughout the unit. A few areas of steeper soils are throughout the unit. These inclusions make up about 13 percent of the unit.

The permeability of this Markton soil is rapid in the upper part of the profile and moderate in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is moderate. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Most areas of this soil are used for cultivated crops. Corn and soybeans are the major crops. Some small areas are used for hay or pasture or are in woodland.

This soil is suitable for corn, soybeans, and small grain. Erosion on steeper slopes and soil blowing are hazards. Wetness hinders normal root growth. Insufficient moisture during the summer months, however, results in droughtiness. Erosion can be controlled by conservation tillage that leaves all or part of the crop residue on the surface, contour strips, stripcropping, cover crops, grassed waterways, terraces, diversions, crop rotation, grade stabilization structures, or a combination of these practices. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion on steeper slopes and soil blowing are hazards. Limitations are wetness and, during the summer months, insufficient moisture resulting in droughtiness. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes erosion and soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes excessive runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months will help control erosion and soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later.

This soil is severely limited for building sites by wetness. An adequate drainage system with storm sewers is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. This soil is severely limited for local roads and streets by frost action. Hauling in suitable fill material and installing road ditches and culverts will help overcome these limitations. This soil is severely limited for septic tank absorption fields by wetness. Connecting sanitary facilities to commercial sewer systems, if possible, should be considered.

This soil is in capability subclass IIIw and woodland suitabilty subclass 3s.

Me—Maumee sand. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are irregular in shape and range from 3 to more than 500 acres in size. The dominant size is about 120 acres.

In a typical profile the surface layer is black sand about 10 inches thick. The subsurface layer is very dark grayish brown, mottled sand about 7 inches thick. The underlying material, to a depth of 60 inches, is dark gray, dark grayish brown, grayish brown, and brown, mottled sand. In some small areas the surface layer is less than 14 inches thick or it is silt loam, sandy loam, or loam. In some areas there is less sand and more clay in the upper part of the profile. In some small areas this soil has a mucky loamy sand surface layer or is more acidic. In a few areas there is a thin, cemented iron layer in the upper part of the profile. There are thin lenses of loamy material in the upper part of the profile in some areas.

Included with this soil in mapping are small areas of moderately well drained Brems and somewhat poorly drained Morocco soils on slightly higher ridges and knolls. Small areas of excessively drained and moderately well drained Plainfield soils are on higher areas. Many small areas of somewhat poorly drained Watseka soils are on slightly higher areas. These inclusions make up about 14 percent of the unit.

The permeability of this soil is rapid. The available water capacity is low. The organic matter content of the surface layer is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas of this soil are used for pasture.

This soil is suitable for blueberries, corn, soybeans, and small grain. Soil blowing, ponding, and frost are hazards. Limitations are insufficient moisture during the summer months, which results in droughtiness, and the soil warming up slowly in the spring. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will also help the soil warm up earlier in the spring. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of ponding and poor filtering qualities of the soil. This soil is severely limited for local roads by ponding. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches and culverts will help overcome this limitation.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

Mh—Maumee mucky sand. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are irregular in shape and range from about 3 to about 80 acres in size. The dominant size is about 20 acres.

In a typical profile the surface layer is black mucky sand about 10 inches thick. The underlying material, to a depth of 60 inches, is dark gray, grayish brown, and brown, mottled sand. In some areas this soil is more acidic. In some small areas this soil has less than 8 inches of muck over the sand. There is more clay in the upper part of the profile in some areas.

Included with this soil in mapping are small areas of very poorly drained Adrian soils in more depressional areas. Adrian soils have more than 16 inches of muck overlying sand. Some small areas of somewhat poorly drained Morocco and Watseka soils are on slightly higher areas. Also included are a few lower areas of very poorly drained soils that have 8 to 16 inches of muck over sand. These inclusions make up about 11 percent of the unit.

The permeability of this Maumee soil is rapid. The available water capacity is low. The organic matter content of the surface layer is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas are used for pasture.

This soil is suitable for blueberries, corn, soybeans, and small grain. Soil blowing, ponding, and frost are hazards. Limitations are insufficient moisture during the summer months, which results in droughtiness, and the soil warming up slowly in the spring. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Delaying cultivation in spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will help the soil warm up earlier in the spring. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited for this use because of ponding and poor filtering qualities of the soil. This soil is severely limited for local roads by ponding. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches and culverts will help overcome this limitation.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

Mn—Maumee Variant loamy sand. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are irregular in shape and range from 3 to about 100 acres in size. The dominant size is about 30 acres.

In a typical profile the surface layer is dark brown loamy sand about 10 inches thick. The subsoil is about 5 inches thick. It is a strong brown, mottled, strongly cemented iron layer. The underlying material, to a depth of 60 inches, is dark grayish brown, grayish brown, and light brownish gray, mottled sand. In a few small areas this soil has no cemented iron layer, and in some of these areas it is more acidic or has more clay in the upper part of the profile. In some small areas the cemented iron layer is at or near the surface. The surface layer is sandy loam, loam, or silt loam in a few areas. In some areas this soil has thin strata of loamy material in the upper part of the underlying material.

Included with this soil in mapping are some small areas of moderately well drained Brems soils and somewhat poorly drained Morocco soils on higher ridges and knolls. A few areas of somewhat poorly drained Watseka soils are on slightly higher areas. These inclusions make up about 5 percent of the unit.

The permeability of this Maumee soil is moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part. The available water capacity is low. The organic matter content of the surface layer is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface. In some areas tillage is difficult because the cemented iron layer is near the surface.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops.

This soil is suitable for blueberries, corn, soybeans, and small grain. Soil blowing, ponding, and frost are hazards. Limitations are insufficient moisture during the summer months resulting in droughtiness, the soil warming up slowly in the spring, and the cemented iron layer at or near the surface. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will also help the soil warm up earlier in the spring. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of ponding, the cemented pan, and poor filtering qualities of the soil. This soil is severely limited for local roads by ponding. Hauling in suitable fill, constructing roads on elevated areas, and installing ditches and culverts will help overcome this limitation.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

MpB—Metea loamy sand, 1 to 4 percent slopes. This nearly level and gently sloping, well drained soil is in broad upland areas and low rises. Mapped areas are irregular in shape and range from 3 to about 250 acres in size. The dominant size is about 20 acres.

In a typical profile the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 51 inches thick. The upper part of the subsoil is yellowish brown, very friable loamy sand; the middle part is yellowish brown, friable fine sandy loam; and the lower part is yellowish brown, friable sandy clay loam and loam. In some small areas this soil has less than 20 inches or more than 40 inches of sandy material in the upper part of the profile. In a few areas there is gravelly loam, gravelly sandy loam, loam, or sandy loam underlying material within 60 inches of the surface. In some areas there are mottles in the lower part of the subsoil.

Included with this soil in mapping are some small areas of somewhat poorly drained Crosier and Markton soils in the lower lying areas. Small areas of excessively drained Plainfield soils are on higher areas. A few areas of well drained Wawasee soils and steeper soils are throughout the unit. Wawasee soils do not have the sandy surface. These inclusions make up about 14 percent of the unit.

The permeability of this Metea soil is rapid in the upper part of the profile and moderate in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is low. Runoff is slow.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Some areas are used for hay or are in woodland.

This soil is suitable for corn, soybeans, and small grain. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Erosion can be controlled by terraces, diversions, conservation tillage that leaves all or part of the crop residue on the surface, contour strips, stripcropping, cover crops, grassed waterways, crop rotation, grade stabilization structures, or a combination of these practices. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Irrigation will reduce the droughtiness. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Overgrazing reduces plant density and hardiness and causes erosion and soil blowing. Proper stocking, timely deferment of grazing, and strip grazing during the summer months will help maintain good plant density and hardiness, control erosion and soil blowing, and keep the pasture and soil in good condition.

This soil is well suited to trees. Seedling mortality and plant competition are moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting or girdling.

This soil is suitable for building sites. It is moderately limited for local roads and streets by frost action. Replacing or covering the upper layer of the soil with a suitable base material will help control frost action. This soil is moderately limited for septic tank absorption fields by moderate permeability in the lower part of the profile. Enlarging the filter field, using a mound system, or connecting the sanitary facilities to a commercial sewer system, where available, are some alternatives to the problem.

This soil is in capability subclass IIIe and woodland suitability subclass 2s.

Mr—Morocco loamy sand. This nearly level, somewhat poorly drained soil is in broad, low lying areas; in depressions; and on low rises. Mapped areas are usually irregular in shape, but some are long and narrow. They range from 3 to about 300 acres in size. The dominant size is about 40 acres.

In a typical profile the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is brown, mottled sand about 5 inches thick. The subsoil is about 13 inches thick. It is brownish yellow, mottled, loose sand. The underlying material, from a depth of about 26 to 45 inches, is pale brown, mottled sand in the upper part and very pale brown, mottled sand in the lower part. Below this, to a depth of about 60 inches, the underlying material is light gray, mottled sand. Some areas of this soil have a dark surface layer more than 10 inches thick. In a few small areas the surface layer is fine sandy loam or sandy loam. In a few areas this soil is slightly acid or neutral in the subsoil and underlying material. In some areas there are thin lenses of loamy material in the upper part of the profile.

Included with this soil in mapping are some small areas of moderately well drained Brems soils on slightly higher ridges and knolls. Some small areas of very poorly drained Maumee soils are in the wetter depressional areas. A few small areas of moderately well drained and excessively drained Plainfield soils are on the highest ridges and knolls. These inclusions make up about 13 percent of the unit.

The permeability of this Morocco soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is very slow. The seasonal high water table fluctuates between depths of 1 foot and 2 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Some areas are used for hay or pasture or are in woodland.

This soil is poorly suited to corn, soybeans, and small grain. It is well suited to blueberries. Soil blowing is a hazard. Wetness hinders normal root growth. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing is a hazard. Limitations are wetness and, during the summer months, insufficient moisture resulting in droughtiness are limitations. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality and plant competition are moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is severely limited for building sites by wetness. An adequate drainage system with storm sewers is needed to lower the water table. Pumping may be necessary if drainage outlets are not available. This soil is moderately limited for local roads and streets by wetness and frost action. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches and culverts will help overcome these limitations. This soil is severely limited for septic tank absorption fields by wetness and poor filtering qualities of the soil. Where possible, connecting sanitary facilities to a commercial sewer system is an alternative to this problem.

This soil is in capability subclass IVs and woodland suitability subclass 3o.

Na—Napoleon muck, undrained. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are usually irregular in shape, but some are round. They range from 3 to about 100 acres in size. The dominant size is about 80 acres.

In a typical profile the surface layer is about 5 inches thick. The upper part of the surface layer is undecomposed leaves; the lower part is very dark brown muck. Organic material extends to a depth of about 60 inches. It is dark brown or very dark brown, friable muck. In many small areas there is less than 51 inches of muck over sand, marl, or a combination of these. The fibers in some small areas are not as well decomposed and are more alkaline.

Included with this soil is mapping are small areas of very poorly drained Newton soils and somewhat poorly drained Watseka soils on small knolls and on the edge of the unit. A few areas are drained. These inclusions make up about 10 percent of the unit.

The permeability of this Napoleon soil is moderate or moderately rapid. The available water capacity is very high. The organic matter content of the surface layer is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface. This soil is extremely acid.

Most areas of this soil are used for woodland. This soil is generally unsuited to crops, but is suited to blueberries. Soil blowing, ponding, and frost are hazards. Overdrainage may result in droughtiness. Limitations are the soil warming up slowly in the spring, the extremely acid reaction, possibility of the muck burning, and subsiding of the muck when drained. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet.

This soil is well suited to grasses and legumes for hay and is poorly suited to pasture. Soil blowing and ponding are hazards. Frost heaving is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil is suitable for trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. The possibility of the muck burning is a limitation. Some equipment limitations can be avoided by harvesting and logging during dry periods or winter months. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Water-tolerant species with deep root systems are best suited to timber stands. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of ponding and low strength. This soil is severely limited for local roads by ponding and frost action. Constructing roads on elevated areas, hauling in suitable fill material, and installing road ditches and culverts will help overcome these limitations.

This soil is in capability subclass VIw and woodland suitability subclass 3w.

Nf—Newton loamy sand. This nearly level, very poorly drained soil is often ponded by adjacent surface runoff. It is in broad, low lying areas and depressions. Mapped areas are irregular in shape and range from 3 to about 200 acres in size. The dominant size is about 40 acres.

In a typical profile the surface layer is black loamy sand about 8 inches thick. The subsurface layer is about 12 inches thick. It is black, mottled loamy sand in the upper part and very dark grayish brown, mottled sand in the lower part. The underlying material, to a depth of 60 inches, is dark grayish brown and grayish brown, mottled sand. In some small areas the surface layer is less than 10 inches thick. In some areas there is more clay in the upper part of the profile, and the soil is slightly acid or neutral throughout. In some small areas the surface layer is sandy loam or mucky loamy sand or is less than 8 inches of muck over sand. In a few areas there are thin lenses of loamy material in the underlying material.

Included with this soil in mapping are some small areas of very poorly drained Adrian soils in more depressional areas. Adrian soils have 16 to 51 inches of muck over sand. Small areas of moderately well drained Brems soils are on higher ridges and knolls. Many small areas of somewhat poorly drained Morocco and Watseka soils are on slightly higher areas. There are a few lower areas of very poorly drained soils that have 8 to 16 inches of muck over sand. These inclusions make up about 10 percent of the unit.

The permeability of this Newton soil is rapid. The available water capacity is low. The organic matter content of the surface layer is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas are used for hay or pasture.

This soil is suitable for corn, soybeans, small grain, and blueberries. Soil blowing, ponding, and frost are hazards. Limitations are insufficient moisture during the summer months resulting in droughtiness, the soil warming up slowly in the spring, and a very acid upper solum. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will also help the soil warm up in the spring. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing and ponding are hazards. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes soil blowing. Grazing during wet periods causes surface compaction, which results in poor tilth, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, and strip grazing during the summer months will help control soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of ponding and poor filtering qualities of the soil. This soil is severely limited for local roads by ponding. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches and culverts will help overcome this limitation.

This soil is in capability subclass IVw and woodland suitability subclass 4w.

OrB—Ormas sand, 1 to 4 percent slopes. This nearly level and gently sloping, well drained soil is in broad, upland areas and on low rises. Mapped areas are irregular in shape and range in size from 5 to about 140 acres. The dominant size is about 20 acres.

In a typical profile the surface layer is dark brown sand about 9 inches thick. The subsoil is about 36 inches thick. The upper part is strong brown, very friable loamy sand; the middle part is strong brown, friable sandy loam; and the lower part is brown, very friable sandy loam. The underlying material, to a depth of about 60 inches, is yellowish brown gravelly coarse sand. In many small areas there is less than 20 inches of sandy material in the upper part of the profile. In some small areas there is more than 40 inches of sandy material in the upper part. In small areas this soil has less than 6 inches of loamy material in the subsoil.

Included with this soil in mapping are some small areas of moderately well drained Brems soils and somewhat poorly drained Ormas Variant soils in lower positions. Many small areas of somewhat excessively drained Coloma soils and excessively drained Plainfield soils are located throughout the unit. A few areas of steeper soils are throughout the unit. These inclusions make up about 14 percent of the unit.

The permeability of this Ormas soil is moderately rapid in the upper part of the profile and very rapid in the lower part. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is slow.

Most areas of this soil are used for cultivated crops. Corn and soybeans are the major crops. Some areas are used for hay or pasture, are in woodland, or are mined for sand and gravel.

This soil is poorly suited to corn, soybeans, and small grain. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Erosion can be controlled by terraces, diversions, conservation tillage that leaves all or part of the crop residue on the surface, contour strips, stripcropping, cover crops, grassed waterways, conservation tillage, crop rotation, grade stabilization structures, or a combination of these practices. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is suitable for grasses and legumes for hay or pasture. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Overgrazing reduces plant density and hardiness and causes erosion and soil blowing. Proper stocking, timely deferment of grazing, strip grazing, and frequent grazing rotations during the summer months will help control erosion and soil blowing, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe, and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for building sites. It is moderately limited for local roads and streets by frost action. Replacing or covering the upper layer of the soil with a suitable base material will help control frost action. This soil is suitable for septic tank absorption fields.

This soil is in capability subclass IIIs and woodland suitability subclass 3s.

OvA—Ormas Variant-Morocco loamy sands, 0 to 2 percent slopes. This map unit consists of nearly level, somewhat poorly drained Ormas Variant and Morocco soils in broad, low lying areas and on low rises. Mapped areas are irregular in shape and range in size from 3 to about 200 acres. The dominant size is about 30 acres. This unit is about 55 percent Ormas Variant soils and about 20 percent Morocco soils. Areas of these soils are so intricately mixed, or so small in size, that it was not practical to separate them in mapping.

In a typical profile of Ormas Variant soil the surface layer is dark grayish brown loamy sand about 8 inches thick. The subsurface layer is brown, mottled loamy sand about 5 inches thick. The subsoil is about 35 inches thick. The upper part of the subsoil is yellowish brown, mottled, very friable loamy sand, and the lower part is gray, mottled, friable sandy loam. The underlying material, to a depth of about 60 inches, is light yellowish brown, mottled loamy sand. In many small areas this soil has less than 20 inches of sandy material in the upper part of the profile. In some small areas there is more than 40 inches of sandy material over the loamy material. The surface layer in a few areas is sandy loam or fine sandy loam.

In a typical profile of Morocco soil the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 19 inches thick. It is yellowish brown, mottled, very friable sand. The underlying material, to a depth of about 60 inches, is yellowish brown, mottled sand. The surface layer in a few areas is sandy loam or fine sandy loam. In some areas the surface layer is thicker and blacker.

Included with these soils in mapping are small, slightly higher areas of moderately well drained Brems soils and some small, lower areas of very poorly drained Gilford soils. A few areas of well drained Ormas soils and excessively drained and moderately well drained Plainfield soils are on the higher ridges and knolls. These inclusions make up about 10 percent of the unit.

The permeability of the Ormas Variant soil is moderately rapid in the solum and very rapid in the underlying material. The permeability of the Morocco soil is rapid. The available water capacity of both soils is low. The organic matter content in the surface layer is low. Runoff is very slow. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Most areas of these soils are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Some small areas are used for hay or pasture or are in woodland.

These soils are suitable for blueberries, corn, soybeans, and small grain. Soil blowing is a hazard. Wetness hinders normal root growth. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Soil blowing can be controlled by windbreaks, conservation tillage that leaves all or part of the crop residues on the surface, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Irrigation can reduce the droughtiness. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of these soils.

These soils are well suited to grasses and legumes for hay or pasture. Soil blowing is a hazard. Wetness and, during the summer months, insufficient moisture resulting in droughtiness are limitations. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

These soils are suitable for trees. Seedling mortality and plant competition are moderate. Planting more trees than necessary will compensate for the seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

These soils are severely limited for building sites by wetness. An adequate drainage system with storm sewers is needed to lower the water table. If drainage outlets are not available, however, pumping may be necessary. Selection of building sites on better suited, nearby soils is suggested. The Ormas Variant soil is severely limited for local roads and streets by frost action. The Morocco soil is moderately limited for local roads and streets by wetness and frost action. Hauling in suitable fill material, contructing roads on elevated areas, and installing road ditches and culverts will help in overcoming these limitations. These soils are severely limited for septic tank absorption fields by wetness and poor filtering qualities of the soil. Connecting the sanitary facilities to a commercial sewer system, where possible, is one alternative to the problem.

These soils are in capability subclass IIIs. The Ormas Variant soil is in woodland suitability subclass 3s, and the Morocco soil is in 3o.

PlA—Plainfield sand, 0 to 1 percent slopes. This nearly level, excessively drained soil is in broad, flat areas and ridgetops in the uplands. Mapped areas are irregular in shape and range in size from 5 to about 100 acres. The dominant size is about 30 acres.

In a typical profile the surface layer is dark brown sand about 12 inches thick. The subsoil is about 8 inches thick. It is yellowish brown, very friable sand. The underlying material, to a depth of 60 inches, is yellowish brown and brownish yellow sand. In some small areas the subsoil has a series of loamy sand bands separated by layers of sand. In some small areas the subsoil has more fine sand. In some areas the subsoil has slightly more silt and clay. In many small areas there are brown mottles in the lower part of the profile.

Included with this soil in mapping are some small, lower areas of moderately well drained Brems soils and somewhat poorly drained Morocco soils. A few areas of steeper soils are throughout the unit. These inclusions make up about 4 percent of the unit.

The permeability of this Plainfield soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is slow.

Most areas of this soil are in woodland, but some are used for hay, pasture, cultivated crops, or urban development. Many of the areas used for cultivated crops are farmed because they are in areas of better suited soils.

This soil is generally unsuited to cultivated crops. Soil blowing is a hazard. Droughtiness and the very acid reaction are limitations. Irrigation can help make this soil suitable for cultivated crops.

This soil is suitable for grasses and legumes for hay or pasture. Soil blowing is a hazard, and droughtiness is a limitation. Overgrazing reduces plant density and hardiness and causes soil blowing. Proper stocking, strip grazing, timely deferment of grazing, and frequent grazing rotations during the summer months will help maintain good plant density and hardiness, control soil blowing, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe, and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for building sites and local roads and streets. It is severely limited, however, for septic tank absorption fields by poor filtering qualities of the soil. The rapid permeability could result in seepage of effluent into ground water suppiles. This soil could be mixed with suitable material to improve the filtering qualities. Connecting sanitary facilities to a commercial sewer system, if one is available, would be an alternative to the problem.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PlB—Plainfield sand, 1 to 8 percent slopes. This nearly level to moderately sloping, excessively drained soil is in broad areas and on ridges, knolls, and long side slopes. Mapped areas are irregular in shape and range in size from 3 to about 200 acres. The dominant size is about 60 acres.

In a typical profile the surface layer is dark grayish brown sand about 7 inches thick. The subsoil is about 17 inches thick. It is strong brown and yellowish brown, very friable sand. The underlying material, to a depth of about 60 inches, is yellowish brown sand. In some small areas the subsoil has a series of loamy sand bands separated by layers of sand. In some small areas there is more fine sand in the subsoil. In some areas the subsoil has slightly more silt and clay. There are brown mottles in the lower part of the profile in some small areas.

Included with this soil in mapping are a few small, lower areas of moderately well drained Brems soils and somewhat poorly drained Morocco soils. A few areas of steeper soils are throughout the unit. These inclusions make up about 5 percent of the unit.

The permeability of this Plainfield soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is slow or medium.

Most areas are used for hay or pasture and cultivated crops. Corn is the major crop. Many areas are in woodland. Some areas are used for urban development. Many of the areas used for cultivated crops are farmed because they are in areas of better suited soils.

This soil is generally unsuited to cultivated crops. Erosion and runoff on steeper slopes and soil blowing are hazards. Droughtiness and the very acid reaction are limitations. The use of irrigation on this soil will help make it suitable for cultivated crops.

This soil is suitable for grasses and legumes for hay or pasture. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Overgrazing reduces plant density and hardiness and causes erosion and soil blowing. Proper stocking, strip grazing, timely deferment of grazing, and frequent grazing rotations during the summer months will help control erosion and soil blowing, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for building sites and local roads and streets. It is severely limited for septic tank absorption fields by poor filtering qualities of the soil. The rapid permeability could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to improve the filtering qualities. Connecting the sanitary facilities to a commercial sewer system, if one is available, would be an alternative to the problem.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PlC—Plainfield sand, 8 to 15 percent slopes. This moderately sloping and strongly sloping, excessively drained soil is on ridges, knolls, and long side slopes. Mapped areas are irregular in shape and range in size from 3 to about 40 acres. The dominant size is about 15 acres.

In a typical profile the surface layer is about 6 inches thick. The upper part is undecomposed leaves; the lower part is very dark grayish brown sand. The subsurface layer is about 3 inches thick. It is dark yellowish brown sand. The subsoil is about 21 inches thick. It is strong brown, very friable sand. The underlying material, to a depth of about 60 inches, is yellowish brown sand. In some small areas the subsoil has a series of loamy sand bands separated by layers of sand. There are some small areas where the subsoil has more fine sand. In some areas the subsoil has slightly more silt and clay. In some small areas this soil has brown mottles in the lower part of the profile.

Included with this soil in mapping are a few small areas of moderately well drained Brems soils and somewhat poorly drained Morocco soils on toe slopes. A few areas of steeper soils are throughout the unit. These inclusions make up about 3 percent of the unit.

The permeability of this Plainfield soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is medium.

Most areas of this soil are used for woodland. Some small areas are used for hay, pasture, or urban development.

This soil is generally unsuited to cultivated crops. Erosion and soil blowing are hazards. Droughtiness, steep slopes, and very acid soil conditions are limitations.

This soil is suitable for grasses and legumes for hay or pasture. Erosion and soil blowing are hazards. Steep slopes and droughtiness are limitations. Overgrazing reduces plant density and hardiness and causes erosion and soil blowing. Proper stocking, strip grazing, timely deferment of grazing, and frequent grazing rotations during the summer months will help control erosion and soil blowing, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe, and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is moderately limited for building sites by slope, but land leveling will help overcome this problem. This soil is moderately limited for local roads and streets by slope. The land could be leveled, or the roads constructed on the contour. This soil is severely limited for septic tank absorption fields by poor filtering qualities of the soil. The rapid permeability could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to improve the filtering qualities. Connecting the sanitary facilities to a commercial sewer system, if one is available, would be an alternative to this problem.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

PtA—Plainfield sand, wet substratum, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is in broad, flat areas, on low rises, and along side slopes. Mapped areas are usually irregular in shape, but some are long and narrow. They range from 3 to about 300 acres in size. The dominant size is about 60 acres.

In a typical profile the surface layer is dark brown sand about 8 inches thick. The subsoil is about 20 inches thick. It is yellowish brown, very friable sand. The underlying material, to a depth of about 44 inches, is yellowish brown and brownish yellow sand. Below this, to a depth of 52 inches, it is brownish yellow, mottled sand. Below this, to a depth of about 60 inches, the underlying material is light yellowish brown, mottled sand. In some small areas the subsoil has more fine sand. In some areas there are small amounts of pebbles and shale fragments throughout the pedon. In small areas there are thin strata of loamy sand in the lower part of the profile. In a few areas there are no mottles in the profile. In some areas there are darker bands in the underlying material. In many areas there are bright mottles above a depth of 40 inches.

Included with this soil in mapping are many small, slightly lower areas of moderately well drained Brems soils. Brems soils are mottled above a depth of 40 inches. Also included are small, more depressional areas of somewhat poorly drained Morocco soils. These inclusions make up about 10 percent of the unit.

The permeability of this Plainfield soil is rapid. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is slow. The seasonal high water table fluctuates between depths of 4 and 6 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Many small areas are in woodland, and some are used for hay, pasture, or urban development.

This soil is poorly suited to corn, soybeans, and small grain. Soil blowing is a hazard. Droughtiness is a limitation. Soil blowing can be controlled by windbreaks, conservation tillage that leaves all or part of the crop residue on the surface, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is suitable for grasses and legumes for hay or pasture. Soil blowing is a hazard, and droughtiness is a limitation. Overgrazing reduces plant density and hardiness and causes soil blowing. Proper stocking, timely deferment of grazing, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe, and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for dwellings without basements. It is moderately limited for dwellings with basements by wetness. An adequate drainage system with storm sewers is needed to lower the water table. Pumping may be necessary, however, if drainage outlets are not available. This soil is suitable for local roads and streets. It is severely limited for septic tank absorption fields by poor filtering qualities of the soil. The rapid permeability could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to improve the filtering qualities. Connecting the sanitary facilities to a commercial sewer system, if one is available, would be an alternative to this problem.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

PvB—Plainfield sand, loamy substratum, 1 to 8 percent slopes. This nearly level to moderately sloping, well drained soil is in broad, upland areas and on low knolls and ridges. Mapped areas are irregular in shape and range in size from 3 to about 150 acres. The dominant size is about 5 acres.

In a typical profile the surface layer is dark brown sand about 10 inches thick. The subsoil is about 45 inches thick. The upper part of the subsoil is yellowish brown, very friable sand; the next part is brownish yellow and yellowish brown, loose sand; the next part is yellowish brown, friable or firm loam; and the lower part is brown, mottled, friable loam. The underlying material, to a depth of about 60 inches, is yellowish brown, mottled loam. In small areas this soil has 20 to 40 inches of sandy material in the upper part of the profile.

Included with this soil in mapping are some small, lower areas of somewhat poorly drained Markton soils. Some small areas of excessively drained Plainfield soils are throughout the unit. A few areas of well drained Wawasee soils that have less than 20 inches of sandy material in the upper part of the profile are on small rises. A few areas of steeper soils are throughout the unit. These inclusions make up about 12 percent of the unit.

The permeability of this Plainfield soil is rapid in the upper part of the profile and moderate in the lower part. The available water capacity is low. The organic matter content of the surface layer is low. Runoff is low or medium.

Most areas of this soil are used for hay and cultivated crops. Corn is the major crop. Some small areas are in woodland.

This soil is poorly suited to corn, soybeans, and small grain. Erosion and runoff on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Erosion and runoff can be controlled by terraces, diversions, conservation tillage that leaves all or part of the crop residue on the surface, contour strips, stripcropping, cover crops, grassed waterways, crop rotation, grade stabilization structures, or a combination of these practices. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage, help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion on steeper slopes and soil blowing are hazards. Droughtiness is a limitation. Overgrazing reduces plant density and hardiness and causes erosion and soil blowing. Proper stocking, strip grazing, timely deferment of grazing, and frequent grazing rotations during the summer months will help control erosion and soil blowing, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Seedling mortality is severe, and plant competition is moderate. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for building sites and local roads and streets. It is severely limited for septic tank absorption fields by poor filtering qualities of the soil. The rapid permeability in the upper part could result in seepage of effluent into ground water supplies. This soil could be mixed with suitable material to improve the filtering qualities. Connecting the sanitary facilities to a commercial sewer system, if one is available, would be an alternative to this problem.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

Px—Prochaska loamy sand, occasionally flooded. This nearly level, very poorly drained soil is occasionally flooded for long periods. It is in broad, low lying areas; in depressions; along drainageways; and in old stream channels. Mapped areas are usually long and narrow, but some are irregular in shape and range in size from 3 to about 250 acres. The dominant size is about 60 acres.

In a typical profile the surface layer is black loamy sand about 9 inches thick. The subsurface layer is very dark gray, mottled loamy sand about 3 inches thick. The subsoil is about 12 inches thick. It is dark gray and black, mottled, very friable sand. The underlying material, to a depth of about 60 inches, is gray, mottled sand in the upper part and grayish brown, mottled coarse sand and sand in the lower part. In some small areas the surface is less than 10 inches thick and in some areas it is sandy loam, fine sandy loam, silt loam, loam, or silty clay loam. This soil has more clay in the upper part of the profile in some areas. In a few areas the underlying material is browner or is very coarse sand.

Included with this soil in mapping are some small areas of very poorly drained Adrian soils. These soils have 16 to 50 inches of muck over sand in the more depressional areas. Many small areas of somewhat poorly drained Algansee soils are on ridges and knolls. Also included are some small, more depressional areas of very poorly drained Suman soils that have loamy subsoil and soils with black and gray sands over muck. These inclusions make up about 9 percent of the unit.

The permeability of this soil is rapid. The available water capacity is low. The organic matter content of the surface layer is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn and soybeans are the major crops. A few small areas are used for wildlife habitat or are in woodland.

This soil is suitable for blueberries, corn, soybeans, and small grain. Soil blowing, flooding, ponding, and frost are hazards. Limitations are insufficient moisture during the summer months resulting in droughtiness and the soil warming up slowly in the spring. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when wet. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation. Levees will help control some flooding. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will also help the soil warm up earlier in spring. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing, flooding, and ponding are hazards. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil is suitable for trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. Some of the equipment limitations can be avoided by harvesting and logging during dry periods or winter months. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Water-tolerant species with deep root systems are best suited to timber stands. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of flooding, ponding, and poor filtering qualities of the soil. This soil is severely limited for local roads by flooding and ponding. Levees will help control some flooding. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches and culverts will help in avoiding excess water.

This soil is in capability subclass IIIw and woodland suitability subclass 3w.

Sh—Shoals Variant loam, rarely flooded. This nearly level, somewhat poorly drained soil is rarely flooded. It is in broad, low lying areas; on low rises on the flood plain; and along drainageways. Mapped areas are irregular in shape and range in size from 5 to about 320 acres. The dominant size is about 90 acres.

In a typical profile the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part of the subsoil is dark grayish brown, mottled, friable sandy clay loam; the next part is strong brown, mottled friable loam; the next part is strong brown, mottled, firm loam; and the lower part is strong brown, mottled, very friable fine sandy loam. The underlying material, to a depth of about 60 inches, is gray, mottled loam in the upper part and grayish brown, mottled fine sand in the lower part. In a few small areas there is less clay in the subsoil or the underlying material is less than 30 inches below the surface. The subsoil in some small areas is dominantly gray. The subsoil in a few areas is browner or has lenses of sand, loamy sand, sandy loam, or fine sandy loam.

Included with this soil in mapping are a few wetter, depressional areas of very poorly drained Craigmile and Suman soils. These inclusions make up about 6 percent of the unit.

The permeability is moderate in the upper part and rapid in the lower part. The available water capacity is high. The organic matter content of the surface layer is moderate. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. A few small areas are used for hay or pasture or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Flooding is a hazard, and wetness is a limitation. Levees will help control flooding. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Conservation tillage that leaves all or part of the crop residue on the surface, green manure crops, and cover crops help to maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Flooding is a hazard, and wetness is a limitation. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is suitable for trees. Plant competition is severe. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of flooding and wetness.

This soil is severely limited for local roads by frost action and low strength. Road ditches with culverts will lower the water table and help reduce frost action. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help to support vehicular traffic and reduce frost action.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

So—Suman silt loam, frequently flooded. This nearly level, very poorly drained soil is frequently flooded for brief to long periods. It is in broad, low lying areas; in depressions; along drainageways; and in old stream channels. Mapped areas are irregular in shape and range in size from 5 to about 550 acres. The dominant size is about 10 acres.

In a typical profile the surface layer is black silt loam about 5 inches thick. The subsurface layer is very dark brown, mottled silt loam about 7 inches thick. The subsoil is about 19 inches thick. It is dark gray, mottled, firm silt loam and silty clay loam. The underlying material, to a depth of about 60 inches, is brown, mottled sand. Depth to the underlying material in a few areas is less than 20 inches or greater than 40 inches. In some areas the surface layer is less than 10 inches thick, and the subsoil in some of these areas is browner. In many small areas there is more gravel in the subsoil and underlying material. The surface layer is fine sandy loam in some areas. In a few areas the underlying material is browner. Thin lenses of silt loam, silty clay loam, muck, or woody fragments are in the underlying material in some pedons.

Included with this soil in mapping are some small, more depressional areas of very poorly drained Adrian soils that are frequently flooded. Adrian soils have 16 to 50 inches of muck over sand. Also included are a few, more depressional areas of very poorly drained soils with black and gray sands over muck. These inclusions make up about 12 percent of the unit.

The permeability is moderately slow in the upper part of the profile and rapid in the lower part. The available water capacity is moderate. The organic matter content of the surface layer is high. Runoff is very slow. The seasonal high water table is at or near the surface.

Most areas of this soil are in woodland or are used for wildlife habitat. Some areas are used for cultivated crops. This soil is suitable for corn, soybeans, and small grain. Flooding, wetness, and frost are hazards. The soil warming up slowly in the spring is a limitation. Machinery bogs down in this soil when wet. Puddling and crusting are problems. Levees will help control some flooding (fig. 6). Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will also help the soil warm up earlier in the spring. Working the soil at the correct moisture content will help control puddling. Conservation practices such as crop residue management, green manure crops, and conservation tillage help to control crusting and maintain and improve the tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Flooding is a hazard. Overgrazing and grazing during wet periods are the major management concerns.

This soil is suitable for trees. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. Some equipment limitations can be avoided by harvesting and logging during dry periods or winter months. Planting more trees than necessary will compensate for seedling mortality, but thinning may be required later. Water-tolerant trees with deep root sytems are best suited to timber stands. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of flooding, wetness, and moderately slow permeability in the upper part of the profile. This soil is severely limited for local roads by flooding, wetness, and low strength. Levees will help control some flooding. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches with culverts will help avoid excess water. Strengthening the base material with sand and gravel or resurfacing the base with more suitable material will help support vehicular traffic.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

To—Toto muck, drained. This nearly level, very poorly drained soil is often ponded by adjacent surface

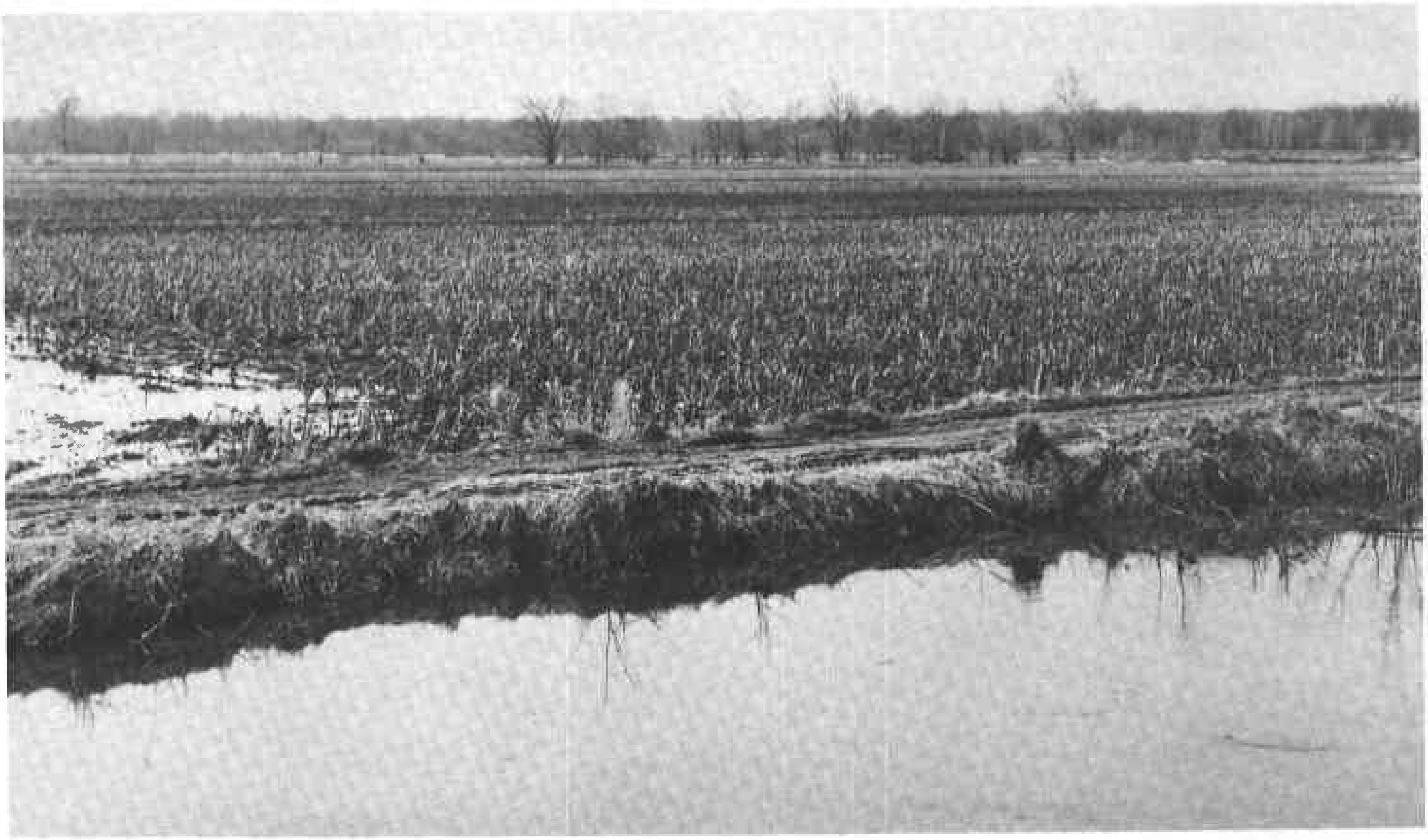


Figure 6.—Levee along the Bailey Ditch helps prevent serious flooding on Suman soils.

runoff. It is in broad, low lying areas and depressions. Mapped areas are irregular in shape and range from 3 to about 100 acres in size. The dominant size is about 20 acres.

In a typical profile the surface layer is black muck about 9 inches thick. The organic material extends to a depth of about 24 inches. It is black and very dark brown, friable muck. Below this, to a depth of 30 inches, is very dark grayish brown, mottled coprogenous earth. Below this, to a depth of 38 inches, is gray, mottled marl. Below this, to a depth of about 60 inches, the underlying material is dark gray, mottled sand in the upper part and yellowish brown, sand in the lower part. In some small areas there is 16 to 50 inches of muck over sand. In some areas there is 8 to 16 inches of muck over coprogenous earth and marl over sand or 8 to 16 inches of muck over marl.

Included with this soil in mapping are small areas of very poorly drained Gilford and Maumee soils on low knolls. These soils do not have a muck surface layer. There are some small areas of somewhat poorly drained Watseka soils on higher knolls. A few areas are undrained. These inclusions make up about 10 percent of the unit.

The permeability is slow in the upper part of the profile and rapid in the lower part. The available water capacity is very high. The organic matter content of the surface layer is very high. Runoff is very slow or ponded. The seasonal high water table is at or above the surface.

Most areas of this soil are used for cultivated crops. Corn and mint are the major crops.

This soil is suitable for corn, mint, and truck crops. Soil blowing, ponding, and frost are hazards. Limitations are the soil warming up slowly in the spring, possibility of the muck burning, and subsiding of the muck when drained. Ponded areas hinder the use of equipment, and machinery bogs down in this soil when it is wet. Management of the water table determines the rate of oxidation. Overdrainage will increase the rate. Soil blowing can be controlled by windbreaks, proper use of crop residues, conservation tillage, stripcropping, a combination of these practices, or permanent vegetation. Delaying cultivation in the spring until the danger of frost passes will reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. These practices will also help the soil warm up faster during the spring. Overdrainage, however, can result in droughtiness.

This soil is well suited to grasses and legumes for hay and is poorly suited to pasture. Soil blowing and ponding are hazards. Frost heaving is a limitation. Overgrazing and grazing during wet periods are the major management concerns.

This soil has severe limitations for building sites and sanitary facilities. It is generally unsuited to these uses because of ponding, low strength, poor filtering qualities of the soil, and the slow and moderately slow permeability in the upper part of the profile. This soil is severely limited for local roads by ponding and frost action. Constructing roads on elevated areas, hauling in suitable fill material, and installing road ditches with culverts will help overcome these limitations.

This soil is in capability subclass IVw and woodland suitability subclass 3w.

Ud—Udorthents gravelly sand. This nearly level, moderately well to excessively drained soil is in depressions. Mapped areas are irregular in shape and range in size from 3 to about 20 acres. The dominant size is about 6 acres.

There is no typical area of Udorthents gravelly sand, but in one excavated area, about 10 to 40 feet deep, the exposed material is gravelly sand and very gravelly sand. This area supports trees, woody shrubs, and herbaceous plants. Some areas do not have any vegetation, and some of these areas are still being mined.

Included with this soil in mapping are some small areas of shallow excavations that contain finer textured materials. Many small areas of steeper soils, mainly at the edge of the unit, are included. Also included are some small, depressional areas of very poorly drained soils with a seasonal high water table at or near the surface. These inclusions make up about 14 percent of the unit.

The permeability of these Udorthents is rapid or very rapid. The available water capacity is very low. The organic matter content of the surface layer is low. Runoff is very slow. The seasonal high water table fluctuates between depths of 2 and 5 feet.

Most areas of this unit are used for wildlife habitat. Some are being mined for sand and gravel.

This unit is generally unsuited to cultivated crops and is poorly suited to hay, pasture, and woodland. Soil blowing is a hazard. Limitations are wetness, droughtiness, the very alkaline reaction, low fertility, and large amounts of gravel and cobblestones.

This unit is not used for building sites, local roads and streets, or septic tank absorption fields because of the position in the landscape. Some areas are excavated up to a depth of about 50 feet.

This unit is in capability subclass VIIs.

Wk—Watseka loamy sand. This nearly level, somewhat poorly drained soil is in broad, low lying areas; on low rises; and in depressional areas. Mapped areas are irregular in shape and range from 3 to about 200 acres in size. The dominant size is about 45 acres.

In a typical profile the surface layer is very dark brown loamy sand about 8 inches thick. The subsurface layer is very dark brown loamy sand about 3 inches thick. The subsoil is about 17 inches thick. It is dark grayish brown and brown, mottled, very friable sand. The underlying material, to a depth of about 60 inches, is light brownish gray, mottled sand in the upper part and light brownish gray sand in the lower part. In some areas the surface is less than 10 inches thick, and in many of these areas the subsoil is browner in the upper part. In a few small areas the surface layer is loam, fine sandy loam, or silt loam.

Included with this soil in mapping are some small areas of moderately well drained Brems soils on slightly higher ridges and knolls. Also included are some small, slightly lower areas of very poorly drained Maumee and Newton soils in slightly lower lying areas. These inclusions make up about 14 percent of the unit.

The permeability of this Watseka soil is rapid. The available water capacity is low. The organic matter content of the surface layer is moderately low. Runoff is very slow. The seasonal high water table fluctuates between depths 1 foot and 3 feet.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Some small areas are used for pasture.

This soil is suitable for blueberries, corn, soybeans, and small grain. Soil blowing and frost are hazards. Wetness hinders normal root growth. Insufficient moisture during the summer months resulting in droughtiness is a limitation. Soil blowing can be controlled by conservation tillage that leaves all or part of the crop residue on the surface, windbreaks, stripcropping, cover crops, a combination of these practices, or by permanent vegetation. Delaying cultivation in the spring until the danger of frost passes will help reduce crop damage. Excess water can be removed by open ditches, subsurface drains, surface drains, pumping, or a combination of these practices. Irrigation will reduce droughtiness. Conservation practices such as crop residue management, green manure crops, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Soil blowing is a hazard. Wetness and, during the summer months, insufficient moisture resulting in droughtiness are limitations. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes soil blowing. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control soil blowing, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is severely limited for building sites by wetness. An adequate drainage system with storm sewers is needed to help lower the water table. Pumping may be necessary, however, if drainage outlets are not available. This soil is moderately limited for local roads and streets by wetness and frost action. Hauling in suitable fill material, constructing roads on elevated areas, and installing road ditches with culverts will help overcome these limitations. This soil is severely limited for septic tank absorption fields by wetness and poor filtering qualities of the soil. Connecting the sanitary facilities to a commercial sewer system, where possible, is an alternative to the problem. Selection of an alternate site is suggested.

This soil is in capability subclass IIIs.

WwB—Wawasee fine sandy loam, 1 to 8 percent slopes. This nearly level to moderately sloping, well drained soil is in broad upland areas and on low knolls and ridges. Mapped areas are irregular in shape and range from 3 to about 120 acres in size. The dominant size is about 15 acres.

In a typical profile the surface layer is dark grayish brown fine sandy loam about 10 inches thick. The subsoil is about 21 inches thick. It is yellowish brown, friable loam. The underlying material, to a depth of about 60 inches, is brown loam. In some areas the surface layer is loamy sand. In some small areas the subsoil is fine sandy loam or sandy loam that is 20 to 30 inches thick. There are a few areas where the underlying material is greater than 40 inches. In some areas there are mottles in the lower part of the underlying material. In a few areas the upper part of the subsoil is incorporated into the surface layer.

Included with this soil in mapping are some small, lower areas of somewhat poorly drained Crosier and Markton soils. Small areas of well drained Metea soils and steeper soils are located throughout the unit. Metea soils have 20 to 40 inches of sand over the loam material. These inclusions make up about 13 percent of the unit.

The permeability of this Wawasee soil is moderate. The available water capacity is high. The organic matter content of the surface layer is moderately low. Runoff is medium.

Most areas of this soil are used for cultivated crops. Corn, soybeans, and small grain are the major crops. Some areas are used for hay or are in woodland.

This soil is well suited to corn, soybeans, and small grain. Erosion and runoff are hazards. They can be controlled by terraces, diversions, conservation tillage that leaves all or part of the crop residue on the surface, contour strips, stripcropping, cover crops, grassed waterways, crop rotation, grade stabilization structures, or a combination of these practices. Conservation practices such as crop residue management, green manure crops, spreading of manure, cover crops, and conservation tillage help to maintain and improve the tilth, moisture content, and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay or pasture. Erosion is a hazard. Overgrazing and grazing during wet periods are the major management concerns. Overgrazing reduces plant density and hardiness and causes erosion. Grazing during wet periods causes surface compaction, which results in poor soil tilth, causes excessive runoff, reduces forage yields, damages the sod, and reduces plant density and hardiness. Proper stocking, timely deferment of grazing, restricted use during wet periods, strip grazing, and frequent grazing rotations during the summer months will help control erosion, reduce surface compaction, maintain good plant density and hardiness, and keep the pasture and soil in good condition.

This soil is well suited to trees. Plant competition is severe. Seedlings grow well if competing vegetation is controlled by plow planting, site preparation, spraying, cutting, or girdling.

This soil is suitable for building sites. It is moderately limited for local roads and streets by frost action. Replacing or covering the upper layer of the soil with a suitable base material will help control frost action. This soil is suitable for septic tank absorption fields.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

prime farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the amount of this high quality farmland is limited, it should be used with wisdom and foresight.

Prime farmland is the land best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when it is treated and managed using acceptable farming methods. With minimal inputs of economic resources, prime farmland produces the highest yields, and farming it results in less damage to the environment than farming other land.

Prime farmland may now be cropland, pasture, woodland, or other types of land except urban and built-up land or water areas. It must either be used for producing food or fiber or available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperatures, an adequate growing season, and suitable acidity or alkalinity. It has few, if any, rocks and is permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods and is not frequently flooded during the growing season. The slope gradient is usually less than 6 percent. For more detailed information on the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

Nearly 37 percent of Starke County, or about 73,000 acres, meets the requirements for prime farmland. It is scattered throughout the county, but there is not as much in the northeast and east-central part. Prime farmland is mainly in map units 2 and 3 of the general soil map. Approximately 68,000 acres of the prime farmland is used for crops, mainly corn and soybeans.

A recent trend in some parts of the county has been the conversion of prime farmland to urban use. Such loss of prime farmland increases farming on marginal lands that generally are more wet or droughty, are difficult to cultivate, and are less productive.

The detailed map units that make up prime farmland in Starke County are listed in this section. This list, however, is not a recommendation for a particular land use. Soils that have limitations—such as a high water table, frequent flooding during the growing season, or inadequate rainfall—may qualify for prime farmland if these limitations are overcome by corrective measures. In the following list, these limitations are indicated in parentheses. Onsite evaluation is necessary, however, to see if the corrective measures are effective.

The map units that meet the soil requirements for prime farmland are:

Co—Craigmile fine sandy loam, frequently flooded (where drained and adequately protected from flooding)
Cp—Craigmile Variant fine sandy loam, rarely flooded (where drained)
CrA—Crosier fine sandy loam, 0 to 3 percent slopes (where drained)
Gf—Gilford sandy loam (where drained)
MdA—Markton sand, 0 to 3 percent slopes
Me—Maumee sand (where drained and subirrigated by controlling the water table)
Mh—Maumee mucky sand (where drained and subirrigated by controlling the water table)
Mn—Maumee Variant loamy sand (where drained and subirrigated by controlling the water table)
MpB—Metea loamy sand, 1 to 4 percent slopes
Nf—Newton loamy sand (where drained and subirrigated by controlling the water table)
Px—Prochaska loamy sand, occasionally flooded (where drained and subirrigated by controlling the water table)
Sh—Shoals Variant loam, rarely flooded (where drained)
So—Suman silt loam, frequently flooded (where drained and adequately protected from flooding)
WwB—Wawasee fine sandy loam, 1 to 8 percent slopes

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

James M. Schwanke, 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 rarely grown in the survey area, are identified; the estimated yields of the main crops and hay and pasture plants are listed for each soil; and the system of land capability classification used by the Soil Conservation Service is explained.

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

More than 115,000 acres in Starke County was used for crops and pasture in 1974. Of this total, 4,073 acres was used for permanent pasture; 96,885 acres for row crops, mainly corn; 3,736 acres for close-grown crops, mainly wheat; 2,888 acres for rotation hay and pasture; and the rest was specialty crops or idle cropland used for conservation purposes (*10*).

The potential of the soils in Starke County for increased production of food is fair. There are a few thousand acres of potentially good cropland currently used as woodland and pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county.

Acreage in agricultural land has gradually been decreasing as more and more land is used for urban development. It was estimated that in 1967 there was about 13,000 acres of urban and built-up land in the county (*5*). Since then this figure has been growing at the rate of about 1,000 acres per year.

Soil *drainage* is the major problem on about 75 percent of the cropland and pasture in Starke County. Most of the very poorly drained soils, such as Maumee, Gilford, Prochaska, and Newton soils, are artificially drained for satisfactory use in agricultural production. A few areas of these soils, however, cannot be economically or satisfactorily drained. These are mostly depressional areas of the Houghton, Adrian, and Edwards soils where drainage ditches to a suitable outlet would have to be deep and extend for great distances.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. In this category are the Crosier, Shoals Variant, and Watseka soils.

The design requirements of both surface and subsurface systems varies with the kind of soil. A combination of surface drainage and subsurface drainage is needed for row cropping on the very poorly drained soils and the somewhat poorly drained soils. Drains have to be more closely spaced in soils with moderately slow permeability than in soils that are more permeable. Subsurface drainage is moderately slow in Suman soils. Finding adequate outlets for subsurface drainage is difficult in some areas of soils such as Newton, Adrian, Houghton, and Edwards soils.

Wawasee soil has good natural drainage most of the year, but it tends to dry out slowly after rains. Commonly mapped with Wawasee soils are small areas of wetter soils along drainageways and in swales. Artificial drainage is needed in some of these wetter areas.

Organic soils oxidize and subside when the water in the pore space is replaced by air. This can be controlled, however, by the use of special drainage systems to regulate the depth and period of drainage. Keeping the water table at the level required for crops during the growing season and raising it to the surface during other parts of the year minimizes the oxidation and subsidence of organic soils. Information on drainage designs for each kind of soil is contained in the Technical Guide available in the local office of the Soil Conservation Service.

Soil blowing is a major soil problem on about 85 percent of the cropland and pasture in Starke County. It is a hazard on mineral soils that have a sandy surface, especially when left bare of vegetation. When drained, the wet, sandy mineral soils and muck soils may even become droughty and subject to soil blowing. Soil blowing can damage emerging crops and remove many tons of topsoil from an acre of land each year. It can be controlled, however, by windbreaks, proper use of crop residues, conservation tillage, stripcropping, cover crops, a combination of these practices, or permanent vegetation.

Water erosion is a major problem on about 2 percent of the cropland and pasture in Starke County. Most of this erosion is in the southeastern part of the county.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and the subsoil is incorporated into the plow layer. This is especially damaging on soils that tend to be droughty, such as Plainfield and Metea soils. In some sloping fields, preparing a good seedbed and tilling are difficult in spots because the original friable surface layer has been eroded away. Such spots are in areas of Wawasee soils. Second, soil erosion results in the pollution of streams by sediment and the reduction of water quality for municipal use, for recreation, and for fish and wildlife.

Erosion control practices generally provide surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can limit erosion losses to amounts that will not reduce the productive capacity of the soils.

On some soils in Starke County, such as Wawasee and Plainfield soils, contour tillage will help control erosion and runoff. Conservation tillage, cover crops, and leaving crop residues on the surface help to increase infiltration and reduce erosion and runoff on the sloping soils. No tillage for corn, which is common on an increasing acreage, is also effective.

Diversions and parallel tile outlet terraces, which are used to shorten slopes, are effective in reducing sheet, rill, and gully erosion. They are most practical on deep, well drained soils such as Wawasee, Plainfield, and Metea soils that are susceptible to erosion. They have also proven effective on Markton soils. The benefits of terracing include a reduction in the loss of soil and associated fertilizer elements; a reduction in sediment damage to crops and water courses; a reduction in the amount of pesticides entering water supplies; and a reduction in the need for grassed waterways, which take productive land out of row crops. Terraces also make it easier to farm on the contour and reduce fuel consumption.

Because of the large number of open ditches in the county, many grade stabilization structures are needed. These structures reduce erosion where surface water drains into an open ditch. Structures are needed in open ditches where there is too much grade and the water moves so rapidly that erosion is a problem on the sides and bottom of the channel.

Soil *fertility* in Starke County ranges from one extreme to the other. Fertility is moderate in most loamy upland soils and low in most sandy upland soils. Most loamy upland soils, such as Wawasee and Crosier soils, are naturally neutral to medium acid. Most sandy upland soils, such as Plainfield and Brems soils, are naturally neutral to very strongly acid.

The soils on flood plains, such as Craigmile Variant and Shoals Variant soils, are neutral to medium acid and are naturally higher in plant nutrients than most upland soils. The very poorly drained soils, such as Gilford and Maumee soils, are in depressional areas and in broad flat areas. They normally are medium acid to neutral and are high in plant nutrients. The muck soils in Starke County, such as Toto, Houghton, and Adrian soils, are neutral to medium acid and are high in most plant nutrients.

Most of these soils require additions of lime or fertilizer for good crop production. Any additions of lime and fertilizer, however, should be based on soil tests, the need of the crop, and the desired level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

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

Many of the soils used for crops in Starke County have a sand, loamy sand, sandy loam, fine sandy loam, or mucky surface layer that is dark and moderate, high, or very high in organic matter content. Generally, the structure of these soils is moderate to weak, which allows good infiltration of water into the soil. Conservation practices such as conservation tillage, crop residue management, green manure crops, and cover crops help to maintain and improve the tilth and organic matter content of these soils.

The dark Suman soils are loamy. Tillage of these soils when they are too wet results in large clods that become firm when they dry. These clods make it difficult to prepare a seedbed.

Field crops suited to the soils and climate of Starke County include some that are rarely grown. Corn, soybeans, and wheat are the main crops. Oats and rye are grown to a limited extent. Grasses and legumes grown include fescue, bromegrass, timothy, crownvetch, clover, and alfalfa.

Specialty crops are of commercial importance in Starke County. A moderate acreage is used for vegetables, small fruits, and mint. Deep soils that have good natural drainage and that warm up early in the spring are especially well suited to many early vegetables and small fruits. These include Metea, Ormas, Wawasee, Plainfield, and Brems soils. Metea, Ormas, Plainfield, and Brems soils would need irrigation for optimum production. Crops can generally be planted and harvested earlier on all these soils than on the other soils in the survey area.

When adequately drained, the muck soils in the county are well suited to a wide variety of vegetable crops and mint. Proper management will insure good yields for many years.

Most of the excessively drained, somewhat excessively drained, well drained, and moderately well drained soils in Starke County are suitable for orchards and nursery plants. Soils in low lying areas, where frost is frequent and air movement is poor, generally are poorly suited to orchards.

Information and suggestions for growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The 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 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

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.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

Mitchell G. Hassler, forester, Soil Conservation Service, helped prepare this section.

Woodland makes up about 23,000 acres, or 12 percent of the county. A significant acreage is in the Kankakee State Fish and Game Area. The rest is privately owned.

Virgin forest once covered almost all of the uplands in Starke County, but the trees have been cleared on most of the land suitable for cultivation. Many of the remaining areas of woodland have soils that are too droughty, too steep, or too wet for farming to be practical.

The largest areas of woodland are in map units 3 and 4 of the general soil map. The most common trees on the uplands are black oak, white oak, eastern white pine, red pine, and jack pine. The main species on bottom lands and wet upland areas are pin oak, cottonwood, river birch, sycamore, and silver maple.

Much of the commercial woodland could be improved by thinning out mature trees and undesirable species. Protection from grazing and fire and control of disease and insects are also needed. The Soil Conservation Service, the Indiana Department of Natural Resources, or the Cooperative Extension Service can help determine specific woodland management needs.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (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 8, *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. 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 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 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

Starke County has several areas of scenic and geologic interest. These areas are used for camping, hiking, hunting, fishing, sightseeing, picnicking, and boating. Public lands available for recreation include Kankakee State Fish and Game Area, Jasper Pulaski Fish and Wildlife Area, and Bass and Koontz Lakes.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have 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

James D. McCall, wildlife biologist, Soil Conservation Service, helped prepare this section.

Starke County has a large and varied population of fish and wildlife. The streams and lakes support suckers, carp, lake perch, bluegills, northern pike, crappies, sunfish, dog fish, catfish, and bass. The lakes and wetlands also provide resting and feeding areas for migratory waterfowl in fall and spring. White-tailed deer, squirrels, thrushes, woodpeckers, raccoon, and opossum inhabit the wooded areas. Quail, cottontails, woodchucks, and many types of songbirds live in the open areas.

Many areas can be improved for wildlife by increasing the food, water supply, and cover that wildlife need.

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

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

The potential of the soil is rated good, fair, poor, or very poor. 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, sorghum, oats, and rye.

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, crownvetch, 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 bluestem, goldenrod, pokeweed, ragweed, crabgrass, dandelion, dock, and switchgrass.

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, riverbirch, maple, tulip tree, willow, walnut, cherry, apple, hawthorn, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, crabapple, serviceberry, hazelnut, elderberry, blackberry, and wild grape.

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, tamarack, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, wild millet, 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 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, robin, red-winged blackbird, meadowlark, field sparrow, cottontail, killdeer, red fox, and woodchuck.

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, weasel, skunks, opossum, squirrels, gray fox, raccoon, and white-tailed 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, shore birds, rails, kingfishers, muskrat, mink, and beaver.

engineering

Max L. Evans, engineer, Soil Conservation Service, helped prepare this section.

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, 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 (fig. 7); and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging,

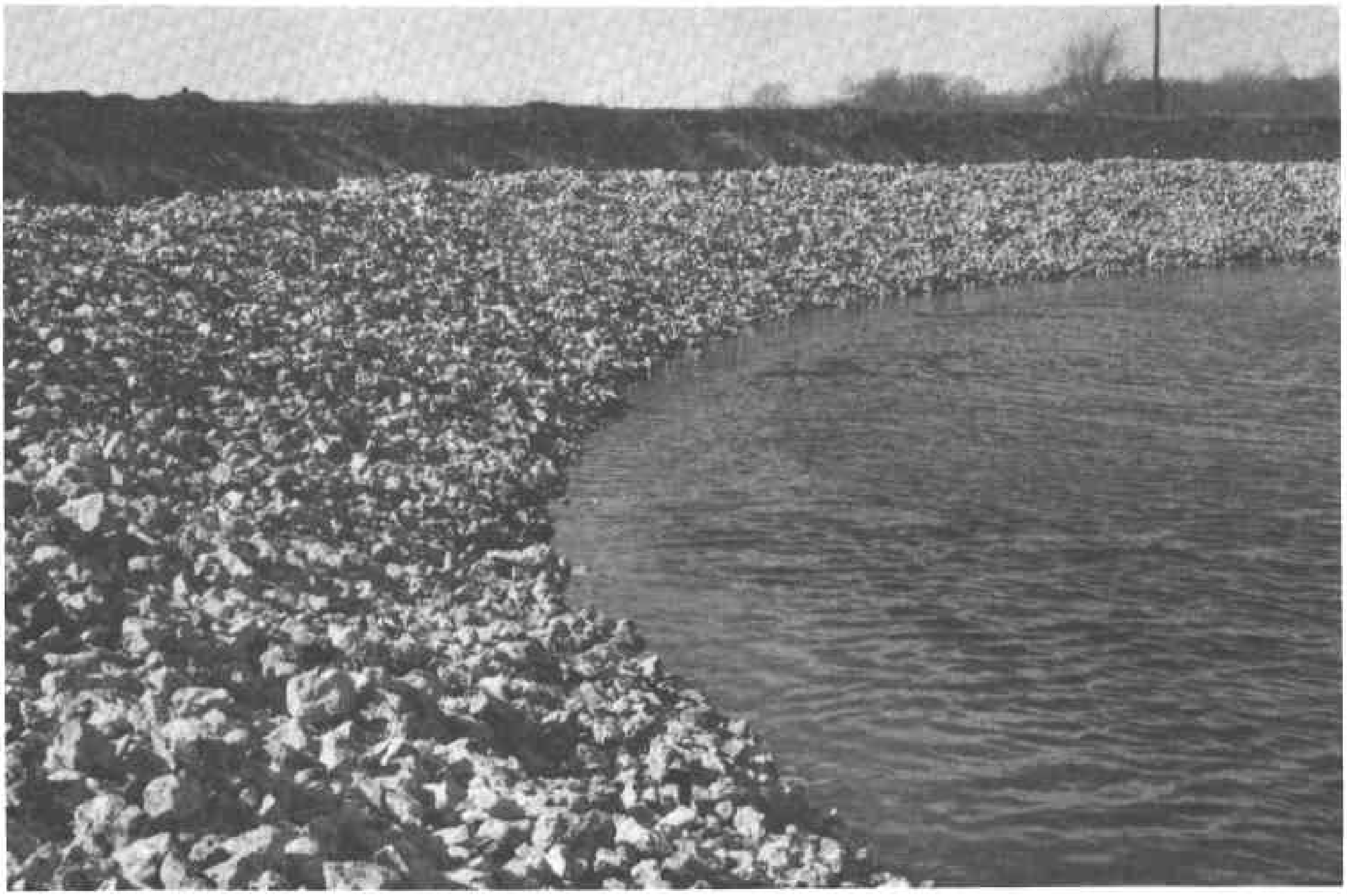


Figure 7.—Riprap placed along the banks of the Yellow River to help prevent the cutbanks from caving on the Shoals Variant soils.

filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

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

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

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

sanitary facilities

Table 13 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 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock 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 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock 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 13 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 excessive 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 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

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

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

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

water management

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

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

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

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

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

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

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

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, 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.

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock 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.

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

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

engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "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 is as much as 15 or 20 percent 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 (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

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

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

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

physical and chemical properties

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

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

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

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

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

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

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.

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

In table 17, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

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

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, 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 no more than once 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 18 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 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. 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 based on many soil borings and on observations during soil mapping. 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.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). 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 Entisol.

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 Psamments (*Psamm*, meaning sand, plus *ents*, from Entisol).

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 Udipsamments (*Udi*, meaning humid, plus *psamments*, the suborder of the Entisols that have a sandy particle size class).

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 *Typic* identifies the subgroup that typifies the great group. An example is Typic Udipsamments.

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 mixed, mesic Typic Udipsamments.

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

soil series and their morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*8*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Adrian series

The Adrian series consists of deep, very poorly drained soils. The permeability is moderately slow to moderately rapid in the organic material and rapid in the lower part of the profile. These soils are on outwash plains, lake plains, and end moraines. They formed in organic deposits over sandy sediment. Slopes range from 0 to 2 percent.

Adrian soils are similar to Edwards, Houghton, Napoleon, and Toto soils and are commonly adjacent to Maumee soils. Edwards soils formed in 16 to 50 inches of muck over marl. Houghton and Napoleon soils formed in muck that is more than 51 inches deep; Toto soils formed in 16 to 35 inches of muck over coprogenous earth, marl, and sand. Maumee soils are sandy and are in slightly higher areas.

Typical pedon of Adrian muck, drained, in a cultivated field, 2,490 feet west and 90 feet north of the southeast corner, sec. 36, T. 33 N., R. 2 W.

Oap—0 to 8 inches; black (N 2/0) broken face and rubbed sapric material; 25 percent fiber, 4 percent rubbed; weak medium granular structure; very friable; many fine and very fine roots; mostly herbaceous fiber; 5 percent mineral content; medium acid; abrupt smooth boundary.

Oa2—8 to 20 inches; black (10YR 2/1) broken face and rubbed sapric material; 40 percent fiber, 8 percent rubbed; strong medium platy structure; friable; few fine roots; mostly herbaceous fiber; few woody fragments 1 to 3 inches in diameter; 3 percent mineral content; medium acid; clear smooth boundary.

Oa3—20 to 36 inches; very dark brown (10YR 2/2) broken face sapric material, black (10YR 2/1) rubbed; 50 percent fiber, 8 percent rubbed; massive; friable; mostly herbaceous fiber; 8 percent mineral content; at a depth of 35 inches is a 1-inch-thick, very dark gray (N 3/0) sapric muck lens with 20 percent mineral content; medium acid; abrupt wavy boundary.

IIC1g—36 to 55 inches; gray (10YR 5/1) sand; single grain; loose; 1/8-inch-thick lens of silt loam; neutral; clear wavy boundary.

IIC2—55 to 60 inches; grayish brown (10YR 5/2) sand; single grain; loose; neutral.

The organic material is 16 to 50 inches thick. It ranges from medium acid to neutral. The material primarily is herbaceous. Some pedons contain woody fragments 1 to 6 inches in diameter.

The surface tier is black (10YR 2/1 or N 2/0). Fiber content is dominantly less than 8 percent when rubbed. In some pedons mineral content is as much as 8 percent. The subsurface and bottom tiers have hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or has hue of N and value of 2 or 3. They are primarily sapric material, but thin layers of hemic material with a combined thickness of less than 10 inches are in some pedons. Fiber content is dominantly less than 10 percent when rubbed. In some pedons mineral content is as much as 12 percent. The organic layer immediately above the IIC horizon has a mineral content of as much as 50 percent. The IIC horizon has hue of 10YR, value of 3 to 6, and chroma of 1 to 3. It is neutral or slightly acid.

Algansee series

The Algansee series consists of deep, somewhat poorly drained, rapidly permeable soils. These soils are on flood plains and formed in sandy alluvial deposits. Slopes range from 0 to 3 percent. In Starke County, these soils have a slightly higher clay content in the A horizon than defined for the Algansee series. This difference does not alter their usefulness or behavior.

The Algansee soils are similar to Algansee Variant soils and are commonly adjacent to Craigmile, Craigmile Variant, and Prochaska soils. Algansee Variant soils have more clay in the lower part of the profile than do Algansee soils. Craigmile soils have a mollic epipedon, are grayer in the upper part of the profile, and have more clay in the upper part of the profile. They are in wetter depressional areas. Craigmile Variant soils have more clay in the upper part of the profile. They are in slightly higher areas. Prochaska soils have a mollic epipedon and are grayer in the upper part of the profile. They are in wetter depressional areas.

Typical pedon of Algansee fine sandy loam, occasionally flooded, in a cultivated field, 500 feet east and 1,570 feet north of the southwest corner, sec. 15, T. 33 N., R. 2 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; common very fine roots; medium acid; abrupt smooth boundary.

A12—9 to 12 inches; dark brown (10YR 3/3) very fine sandy loam, pale brown (10YR 6/3) dry; common fine distinct dark gray (10YR 4/1) and dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; very friable; common very fine roots; medium acid; abrupt smooth boundary.

C1—12 to 16 inches; dark brown (10YR 4/3) fine sand; many fine faint dark grayish brown (10YR 4/2), many fine distinct grayish brown (10YR 5/2), and many fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very friable; slightly acid; abrupt wavy boundary.

C2—16 to 22 inches; dark brown (10YR 4/3) loamy fine sand; many medium distinct grayish brown (10YR 5/2), common fine distinct strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

C3—22 to 26 inches; grayish brown (10YR 5/2) loamy fine sand; common medium distinct dark gray (10YR 4/1), common fine distinct strong brown (7.5YR 5/6), and few fine prominent reddish brown (5YR 4/4) mottles; single grain; loose; few 1/4-inch-thick lenses of very dark grayish brown (10YR 3/2) fine sand; neutral; gradual wavy boundary.

C4—26 to 31 inches; brown (10YR 5/3) fine sand; common medium faint grayish brown (10YR 5/2), common medium distinct yellowish brown (10YR 5/4), and common fine distinct strong brown (7.5YR 5/6) mottles; single grain; loose; few 1/4-inch-thick lenses of very dark grayish brown (10YR 3/2) fine sand; slight effervescence; mildly alkaline; gradual wavy boundary.

C5—31 to 37 inches; brown (7.5YR 5/4) fine sand; few fine distinct gray (10YR 5/1), many medium distinct grayish brown (10YR 5/2), few medium distinct yellowish brown (10YR 5/6), and few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; few 1/4-inch-thick lenses of very dark gray (10YR 3/1) fine sand; slight effervescence; mildly alkaline; gradual wavy boundary.

C6—37 to 42 inches; grayish brown (10YR 5/2) loamy fine sand; common medium faint gray (10YR 5/1) and light brownish gray (10YR 6/2), few medium distinct brownish yellow (10YR 6/6), and few fine prominent dark red (2.5YR 3/6) mottles; single grain; loose; few 1/4-inch to 1-inch-thick lenses of dark grayish brown (10YR 4/2) silt loam; slight effervescence; mildly alkaline; gradual wavy boundary.

C7—42 to 50 inches; grayish brown (10YR 5/2) fine sand; common medium faint brown (10YR 5/3), many medium distinct yellowish brown (10YR 5/4), common fine distinct strong brown (7.5YR 5/6), and few fine prominent yellowish red (5YR 5/8) mottles; single grain; loose; slight effervescence; mildly alkaline; gradual wavy boundary.

C8—50 to 60 inches; brown (10YR 5/3) fine sand; few medium faint pale brown (10YR 6/3), common medium distinct light brownish gray (10YR 6/2), common fine distinct strong brown (7.5YR 5/6), and few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; few 1/4-inch-thick lenses of dark gray (10YR 4/1) silt loam; slight effervescence; mildly alkaline.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is fine sandy loam, very fine sandy loam, or loamy fine sand. The C horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. It is loamy fine sand, fine sand, sand, or loamy sand. Most pedons have thin strata of sandy loam, fine sandy loam, loam, or silt loam. The C horizon ranges from medium acid to mildly alkaline.

Algansee Variant

The Algansee Variant consists of deep, somewhat poorly drained soils. The permeability is rapid in the sandy material and moderately rapid in the loamy and silty material. These soils are on flood plains and formed in alluvium consisting of sandy deposits over loamy and silty sediment (fig. 8). Slopes range from 0 to 2 percent.

Algansee Variant soils are similar to Algansee soils and are commonly adjacent to Craigmile, Prochaska, and Suman soils. Algansee soils have less clay in the lower part of the profile than do Algansee Variant soils.

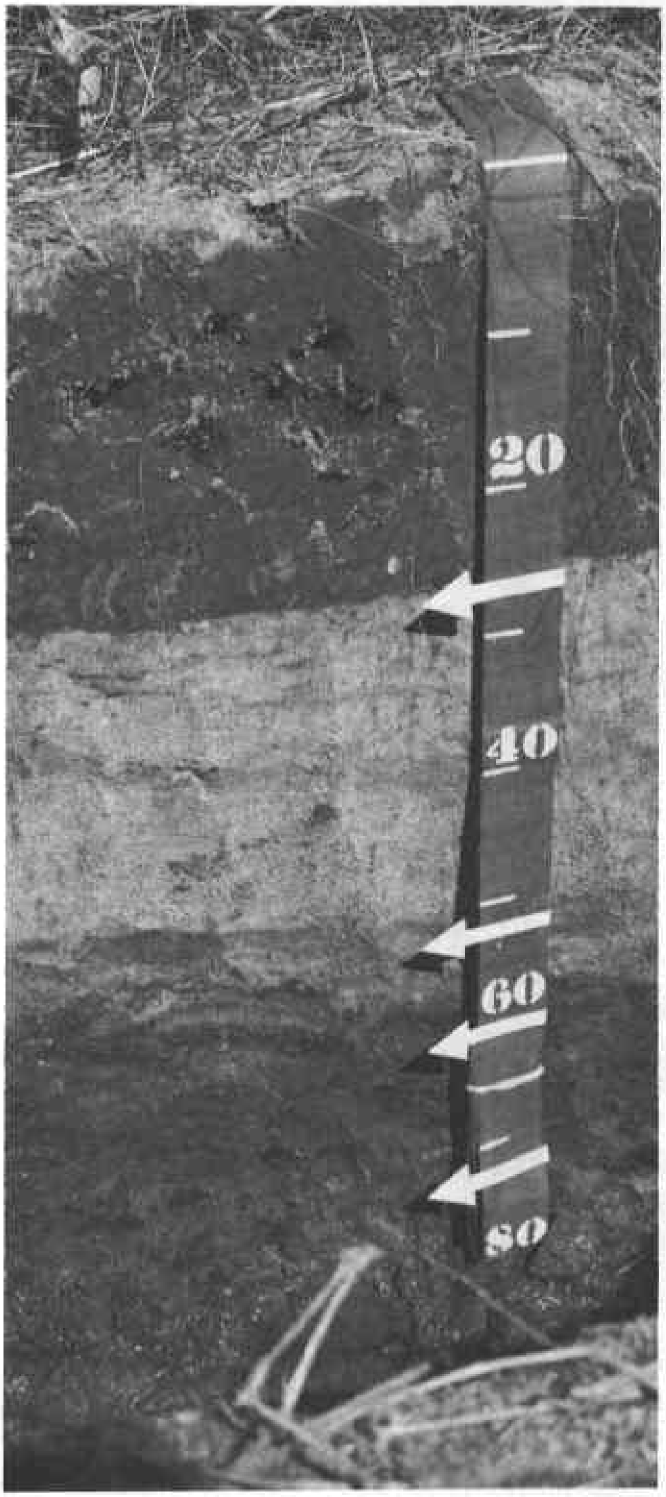


Figure 8.—Profile of Algansee Variant sand, occasionally flooded. Note the original soil surface at a depth of about 60 centimeters.

Craigmile and Suman soils have mollic epipedons, have more clay, and are grayer in the upper part of the profile. They are in wetter depressional areas. Prochaska soils have a mollic epipedon, have less clay in the lower part of the profile, and are grayer in the upper part of the profile. They are in wetter depressional areas.

Typical pedon of Algansee Variant sand, occasionally flooded, in a cultivated field, 60 feet east and 710 feet north of the southwest corner, sec. 18, T. 33 N., R. 2 W.

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

C1—9 to 22 inches; yellowish brown (10YR 5/4) sand; many medium faint yellowish brown (10YR 5/6) and few medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; few fine and very fine roots; few 1/4-inch-thick lenses of dark brown (10YR 3/3) loamy sand; neutral; abrupt wavy boundary.

C2—22 to 29 inches; yellowish brown (10YR 5/4) sand; many medium distinct yellowish brown (10YR 5/8) and light brownish gray (10YR 6/2) and few fine distinct dark yellowish brown (10YR 4/6) mottles; single grain; loose; few 1/4-inch-thick lenses of dark brown (10YR 3/3) loamy sand; neutral; abrupt wavy boundary.

IIAb—29 to 40 inches; very dark gray (10YR 3/1) sandy loam; moderate medium subangular blocky structure; friable; common red (2.5YR 4/8) root channels; neutral; clear wavy boundary.

IIC3g—40 to 53 inches; dark gray (10YR 4/1) sandy loam; few medium distinct dark brown (7.5YR 3/4) and many medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; common red (2.5YR 4/8) root channels; neutral; abrupt wavy boundary.

IIC4g—53 to 60 inches; gray (10YR 5/1) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; thin lenses of yellowish brown (10YR 5/4) loamy sand; neutral.

The sandy overwash is 20 to 40 inches thick. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is sand, loamy sand, or loamy fine sand. The C horizon has hue of 10YR, value of 4 to 7, and chroma of 1 to 4. It is fine sand, sand, coarse sand, loamy sand, or loamy fine sand. It ranges from neutral to medium acid. The IIAb horizon has hue of 10YR or neutral, value or 2 to 4, and chroma of 0 to 2. It is silt loam, sandy loam, fine sandy loam, or loam. It is neutral or slightly acid. The IICg horizon has hue of 10YR, value of 2 to 6, and chroma of 1 or 2. It is sandy loam, loam, silt loam, or fine sandy loam and is neutral or slightly acid. Some pedons have a IIIC horizon.

Brems series

The Brems series consists of deep, moderately well drained, rapidly permeable soils on outwash plains. These soils formed in sandy deposits. Slopes range from 0 to 3 percent. In Starke County, these soils do not have mottles with chroma of 2 or less within 40 inches of the surface, which is uncharacteristic of the Brems series. This difference does not alter their usefulness or behavior.

Brems soils are commonly adjacent to Maumee, Morocco, Plainfield, and Watseka soils. Maumee soils have a mollic epipedon and are grayer throughout the profile than Brems soils. They are in wetter depressional areas. Morocco soils have gray mottles above a depth of 20 inches and are in slightly lower areas. Plainfield soils are browner in the lower part of the pedon and are on higher ridges and knolls. Watseka soils have a mollic epipedon and are grayer in the solum. They are in slightly lower areas.

Typical pedon of Brems sand, 0 to 3 percent slopes, in a cultivated field, 400 feet east and 320 feet north of the center, sec. 6, T. 33 N., R. 1 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.

B21—8 to 15 inches; strong brown (7.5YR 5/8) sand; few fine distinct yellowish red (5YR 5/8) mottles; weak fine granular structure; very friable; common fine and very fine roots; medium acid; clear wavy boundary.

B22—15 to 23 inches; yellowish brown (10YR 5/8) sand; few fine distinct strong brown (7.5YR 5/8) mottles; weak fine granular structure; very friable; common fine and very fine roots; strongly acid; clear wavy boundary.

B23—23 to 28 inches; yellowish brown (10YR 5/8) sand; many medium distinct strong brown (7.5YR 5/8) mottles; weak fine granular structure; very friable; few fine roots; medium acid; clear irregular boundary.

B3—28 to 44 inches; yellowish brown (10YR 5/6) sand; many medium distinct pale brown (10YR 6/3), common fine distinct strong brown (7.5YR 5/8) and few fine prominent yellowish red (5YR 5/8) mottles; single grain; loose; medium acid; clear wavy boundary.

C1—44 to 48 inches; light yellowish brown (10YR 6/4) sand; many medium faint pale brown (10YR 6/3) and many medium distinct yellowish brown (10YR 5/6) mottles; single grain; very friable; slightly acid; clear wavy boundary.

C2—48 to 60 inches; pale brown (10YR 6/3) sand; many medium distinct yellowish brown (10YR 5/4), few fine faint light brownish gray (10YR 6/2) and few fine prominent yellowish red (5YR 5/8) mottles; single grain; very friable; slightly acid.

The solum is 35 to 50 inches thick. The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is sand or loamy sand. The B2 horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 8. It is sand or loamy sand and ranges from medium acid to very strongly acid. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6.

Coloma series

The Coloma series consists of deep, somewhat excessively drained, rapidly permeable soils on outwash plains. These soils formed in sandy sediment. Slopes range from 0 to 6 percent.

Coloma soils are similar to Plainfield soils and are commonly adjacent to Brems and Morocco soils. Plainfield, Brems, and Morocco soils do not have thin, banded A&B horizons above a depth of 60 inches. Brems soils are grayer than Coloma soils in the lower part of the profile and are in slightly lower areas. Morocco soils are grayer throughout the profile and are in lower areas.

Typical pedon of Coloma sand, 0 to 6 percent slopes, in a cultivated field, 180 feet east and 825 feet north of the center, sec. 27, T. 32 N., R. 3 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common very fine roots; medium acid; abrupt smooth boundary.

A2—10 to 20 inches; yellowish brown (10YR 5/4) sand; weak medium subangular blocky structure; very friable; few very fine roots; medium acid; gradual wavy boundary.

A&B—20 to 60 inches; light yellowish brown (10YR 6/4) sand (A part); single grain; loose; and bands of dark brown (7.5YR 4/4) loamy sand (B part); massive; very friable; bands are below a depth of 40 inches; bands are 1/8 to 1 inch thick, are discontinuous, and have a cumulative thickness of 4 inches; clay bridges connect sand grains in the bands; medium acid.

The solum is 50 inches to many feet thick. The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The A part of the A&B horizon has hue of 10YR, value of 5 or 6, and chroma of 4. The B part has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is medium acid or strongly acid.

Craigmile series

The Craigmile series consists of deep, very poorly drained soils. The permeability is moderately rapid in the loamy material and rapid in the sandy material. These soils are on flood plains and formed in alluvium consisting of loamy sediment over sandy deposits. Slopes range from 0 to 2 percent.

Craigmile soils are similar to Prochaska and Suman soils and are commonly adjacent to Algansee and Algansee Variant soils. Prochaska soils have less clay in the upper part of the profile than do Craigmile soils. Suman soils have more clay in the upper part of the profile. Algansee and Algansee Variant soils have an ochric epipedon, are browner, and have less clay in the upper part of the profile. They are on slightly higher areas.

Typical pedon of Craigmile fine sandy loam, frequently flooded, in a cultivated field, 100 feet west and 1,740 feet south of the center, sec. 16, T. 33 N., R. 2 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; common very fine roots; slightly acid; abrupt wavy boundary.

A12—9 to 12 inches; black (10YR 2/1) fine sandy loam, gray (10YR 5/1) dry; many fine distinct dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; very friable; common very fine roots; slightly acid; abrupt wavy boundary.

Clg—12 to 25 inches; grayish brown (10YR 5/2) fine sandy loam; few fine distinct strong brown (7.5YR 5/8), many fine distinct yellowish brown (10YR 5/4), and few fine prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; very friable; few very dark gray (10YR 3/1) worm and crayfish channels; few thin lenses of grayish brown (10YR 5/2) loamy fine sand and silt loam; neutral; clear irregular boundary.

C2g—25 to 30 inches; dark gray (10YR 4/1) loamy sand; many medium distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) and many medium faint dark grayish brown (10YR 4/2) mottles; single grain; loose; neutral; clear irregular boundary.

C3g—30 to 48 inches; very dark gray (10YR 3/1) loamy sand; common fine distinct grayish brown (10YR 5/2), many medium distinct grayish brown (10YR 4/2), and few fine distinct strong brown (7.5YR 5/6) mottles; single grain; very friable; few thin lenses of very dark gray (10YR 3/1) sand and silt loam; neutral; clear wavy boundary.

C4—48 to 60 inches; brown (10YR 5/3) sand; common medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; slight effervescence; mildly alkaline.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is fine sandy loam, sandy loam,

loam, or loamy sand. The C horizon has hue of 10YR, value of 3 to 6, and chroma of 1 to 3. It is fine sandy loam or loam in the upper part. The C horizon is slightly acid or neutral in the upper part.

Craigmile Variant

The Craigmile Variant consists of deep, somewhat poorly drained soils. The permeability is moderately rapid in the loamy material and rapid in the sandy material. These soils are on flood plains and formed in alluvium consisting of loamy sediment over sandy deposits. Slopes range from 0 to 2 percent.

Craigmile Variant soils are commonly adjacent to Algansee, Craigmile, and Shoals Variant soils. Algansee soils have less clay in the upper part of the profile than do Craigmile Variant soils. They are in slightly lower areas. Craigmile soils have a mollic epipedon and are grayer in the upper part of the profile. They are in wetter depressional areas. Shoals Variant soils have more clay in the subsoil. They are in slightly higher areas.

Typical pedon of Craigmile Variant fine sandy loam, rarely flooded, in a cultivated field, 1,520 feet east and 160 feet north of the southwest corner, sec. 10, T. 33 N., R. 2 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; common fine and very fine roots; slightly acid; abrupt smooth boundary.

B21tg—9 to 23 inches; gray (10YR 5/1) fine sandy loam; many medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) and few medium prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; friable; thin discontinuous dark gray (10YR 4/1) clay films on faces of peds; common very fine roots; many very dark gray (10YR 3/1) worm casts and root channels; thin lenses of loamy sand; slightly acid; abrupt wavy boundary.

B22t—23 to 31 inches; brown (10YR 5/3) fine sandy loam; many medium distinct strong brown (7.5YR 5/6), few fine prominent yellowish red (5YR 5/8), and common medium distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; friable; thin discontinuous brown (10YR 5/3) clay films on faces of peds; common very fine roots; slightly acid; clear irregular boundary.

B3—31 to 38 inches; brown (10YR 5/3) loamy fine sand; many medium distinct strong brown (7.5YR 5/6), few fine prominent yellowish red (5YR 5/8), common medium distinct gray (10YR 5/1), and common medium faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm, slightly hard when dry; few very fine roots; slightly acid; clear wavy boundary.

C1—38 to 49 inches; pale brown (10YR 6/3) fine sand; common medium distinct yellowish brown (10YR 5/4) and common medium faint brown (10YR 5/3) mottles; single grain; loose; thin lens of very dark gray (10YR 3/1) sand; neutral; abrupt wavy boundary.

C2—49 to 60 inches; yellowish brown (10YR 5/4) sand; many medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; less than 1 percent gravel; thin lenses of black (10YR 2/1) silt loam with woody fragments at depths of 49 and 54 inches; neutral.

The solum is 30 to 50 inches thick. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is fine sandy loam or sandy loam. The B2t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 6. It is sandy loam, fine sandy loam, sandy clay loam, or loam. Most pedons have thin lenses of sand, loamy sand, or silt loam. Reaction is neutral or slightly acid. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4. It is fine sand, sand, or coarse sand. Most pedons have thin lenses of fine sandy loam, silt loam, loamy fine sand, sand, muck, or woody fragments. Reaction is slightly acid or neutral.

Crosier series

The Crosier series consists of deep, somewhat poorly drained soils. The permeability is moderately slow. These soils are on end moraines and formed in loamy glacial till. Slopes range from 0 to 3 percent.

Crosier soils are commonly adjacent to Markton, Metea, and Wawasee soils. Markton soils are in the same positions as Crosier soils, but have less clay in the upper part of the solum. Metea soils have less clay in the upper part of the solum and are browner throughout the profile. They are on higher ridges and knolls. Wawasee soils are browner throughout the profile and are on higher positions in the landscape.

Typical pedon of Crosier fine sandy loam, 0 to 3 percent slopes, in a cultivated field, 325 feet west and 160 feet north of the southeast corner, sec. 1, T. 32 N., R. 1 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; friable; 4 percent gravel, 2 percent cobblestones; many very fine roots; slightly acid; abrupt smooth boundary.

B21t—9 to 16 inches; brown (10YR 5/3) loam; common fine distinct yellowish brown (10YR 5/6) and few fine distinct brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; medium continuous light brownish gray (10YR 6/2) clay films on faces of peds; 1 percent gravel; common very fine roots; common dark brown (10YR 3/3) root channels and worm casts; medium acid; clear wavy boundary.

B22t—16 to 21 inches; yellowish brown (10YR 5/4) clay loam; many medium faint yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; strong fine angular blocky structure; firm; medium continuous grayish brown (10YR 5/2) clay films on faces of peds; 2 percent gravel; common very fine roots; common dark brown (10YR 3/3) root channels and worm casts; medium acid; clear wavy boundary.

B23t—21 to 30 inches; yellowish brown (10YR 5/4) clay loam; common medium faint brown (10YR 5/3) and few medium prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; 1 percent gravel; neutral; clear irregular boundary.

C1—30 to 36 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and few fine distinct yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; massive; friable; 2 percent gravel; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—36 to 60 inches; yellowish brown (10YR 5/4) loam; many fine distinct yellowish brown (10YR 5/8) mottles; massive; friable; 2 percent gravel; few light gray (10YR 7/1) lime segregations; strong effervescence; mildly alkaline.

The solum is 24 to 40 inches thick. Coarse fragments throughout the solum range from 1 to 10 percent by volume. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is fine sandy loam or sandy loam. The B2t horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is clay loam or loam. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is loam or sandy loam.

Edwards series

The Edwards series consists of deep, very poorly drained soils. The permeability is moderately slow to moderately rapid. These soils are on outwash plains, lake plains, and end moraines. They formed in organic deposits over marl. Slopes range from 0 to 2 percent.

Edwards soils are similar to Adrian, Houghton, Napoleon, and Toto soils and are commonly adjacent to Maumee soils. Adrian soils formed in 16 to 50 inches of muck over sand. Houghton and Napoleon soils formed in muck that is more than 51 inches deep. Toto soils formed in 16 to 35 inches of muck over coprogenous earth, marl, and sand. Maumee soils are sandy and are in slightly higher areas than Edwards soils.

Typical pedon of Edwards muck, drained, in a cultivated field, 1,200 feet east and 1,450 feet north of the center, sec. 13, T. 32 N., R. 1 W.

Oap—0 to 9 inches; black (N 2/0) broken face and rubbed sapric material; 35 percent fiber, 4 percent rubbed; moderate medium granular structure; friable; many fine and very fine roots; mostly herbaceous fiber; 4 percent mineral content; medium acid; abrupt smooth boundary.

Oa2—9 to 22 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; 60 percent fiber, 7 percent rubbed; moderate thin platy structure; friable; common fine and very fine roots; mostly herbaceous fiber; 5 percent mineral content; at 20 inches, common shell fragments; slightly acid; abrupt wavy boundary.

Lca1—22 to 47 inches; gray (10YR 6/1) marl; massive; very friable; common partially decomposed roots; many white (10YR 8/1) shells and shell fragments; violent effervescence; moderately alkaline; clear wavy boundary.

Lca2—47 to 60 inches; grayish brown (10YR 5/2) marl; massive; very friable; common partially decomposed roots; many white (10YR 8/1) shells and shell fragments; violent effervescence; moderately alkaline.

The organic material is 16 to 50 inches thick. It ranges from medium acid to mildly alkaline. The material primarily is herbaceous. Some pedons contain woody fragments 1 to 5 inches in diameter. The surface tier has hue of 10YR or neutral, value of 2, and chroma of 0 to 2. Fiber content is dominantly less than 7 percent when rubbed. In some pedons mineral content is as much as 10 percent. The subsurface and bottom tiers have hue of 7.5YR, 10YR, or neutral; value of 2 or 3; and chroma of 0 to 2. They are primarily sapric material, but thin layers of hemic material with a combined thickness of less than 10 inches are in some pedons. Fiber content is dominantly less than 10 percent when rubbed. In some pedons mineral content is as much as 15 percent. Small shells or shell fragments are in the organic material near the marl contact and are mixed throughout some pedons. The Lca horizon has hue of 10YR, value of 5 to 7, and chroma of 1 or 2. It is mildly alkaline or moderately alkaline.

Gilford series

The Gilford series consists of deep, very poorly drained soils. The permeability is moderately rapid in the solum and rapid in the underlying material. These soils are on outwash plains and formed in sandy sediment. Slopes range from 0 to 2 percent.

Gilford soils are similar to Maumee and Newton soils and are commonly adjacent to Morocco soils. Maumee and Newton soils have less clay in the upper part of the profile than do Gilford soils. Newton soils are more acid. Morocco soils have an ochric epipedon, have less clay in the upper part of the solum, and are browner in the upper part of the profile. They are on slightly higher ridges and knolls.

Typical pedon of Gilford sandy loam, in a cultivated field, 120 feet east and 200 feet south of the northwest corner, sec. 13, T. 34 N., R. 2 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; friable; 1 percent gravel; common fine roots; neutral; abrupt smooth boundary.

A12—10 to 15 inches; black (N 2/0) sandy loam, very dark brown (10YR 2/2) dry; common fine distinct brown (10YR 4/3) mottles; moderate medium subangular blocky structure; friable; 1 percent gravel; common fine and very fine roots; neutral; abrupt wavy boundary.

B21g—15 to 26 inches; dark gray (10YR 4/1) sandy loam; many fine distinct yellowish brown (10YR 5/4) and common medium distinct grayish brown (10YR 5/2) and brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; 1 percent gravel; common fine and very fine roots; few black (10YR 2/1) crayfish channels; thin lenses of dark gray (10YR 4/1) loamy sand; slightly acid; clear wavy boundary.

B22g—26 to 34 inches; dark grayish brown (10YR 4/2) sandy loam; many medium distinct brown (10YR 5/3) and yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; 1 percent gravel; few very fine roots; few dark gray (10YR 4/1) crayfish channels; thin lenses of dark grayish brown (10YR 4/2) loamy sand; slightly acid; abrupt irregular boundary.

C1—34 to 39 inches; dark grayish brown (10YR 5/2) loamy sand; many medium faint gray (10YR 5/1), and many medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; very friable; 2 percent gravel; few very fine roots; few black (10YR 2/1) crayfish channels; neutral; abrupt wavy boundary.

C2—39 to 47 inches; pale brown (10YR 6/3) sand; single grain; loose; 1 percent gravel; few dark gray (10YR 4/1) crayfish channels; neutral; clear wavy boundary.

C3—47 to 60 inches; brown (10YR 5/3) sand; single grain; loose; 1 percent gravel; neutral.

The solum is 20 to 40 inches thick. The amount of gravel ranges from 0 to 7 percent by volume in the solum. The A horizon has hue of 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. It is sandy loam or fine sandy loam. The B2g horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. It is sandy loam or fine sandy loam. Some pedons have a B3 horizon. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 3. It is sand or loamy sand. The amount of gravel ranges from 0 to 7 percent by volume.

Houghton series

The Houghton series consists of deep, very poorly drained soils. The permeability is moderately slow to moderately rapid. These soils are on outwash plains, lake plains, and end moraines. They formed in organic deposits. Slopes range from 0 to 2 percent.

Houghton soils are similar to Adrian, Edwards, Napoleon, and Toto soils and are commonly adjacent to Maumee soils. Adrian soils formed in 16 to 50 inches of muck over sand. Edwards soils formed in 16 to 50 inches of muck over marl. Napoleon soils are more fibrous and more acid throughout than Houghton soils. Toto soils formed in 16 to 35 inches of muck over coprogenous earth, marl, and sand. Maumee soils are sandy and are on slightly higher areas.

Typical pedon of Houghton muck, drained, in a cultivated field, 500 feet east and 1,800 feet north of the southwest corner, sec. 32, T. 33 N., R. 2 W.

Oap—0 to 10 inches; black (10YR 2/1) broken face and rubbed sapric material; 30 percent fiber, 4 percent rubbed; weak coarse subangular blocky structure; very friable; many fine and very fine roots; mostly herbaceous fiber; 4 percent mineral content; medium acid; abrupt smooth boundary.

Oa2—10 to 15 inches; black (10YR 2/1) broken face and rubbed sapric material; 40 percent fiber, 5 percent rubbed; strong coarse subangular blocky structure; friable; common fine roots; mostly herbaceous fiber; 4 percent mineral content; medium acid; abrupt wavy boundary.

Oa3—15 to 32 inches; very dark brown (10YR 2/2) broken face sapric material, black (10YR 2/1) rubbed; 50 percent fiber, 7 percent rubbed; massive; friable; few very fine roots; mostly herbaceous fiber; 2 percent mineral content; medium acid; clear wavy boundary.

Oa4—32 to 50 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; 50 percent fiber, 10 percent rubbed; massive; friable; mostly herbaceous fiber; 1 percent mineral content; medium acid; clear wavy boundary.

Oa5—50 to 60 inches; very dark brown (10YR 2/2) broken face sapric material, black (10YR 2/1) rubbed; 50 percent fiber, 8 percent rubbed; massive; very friable; mostly herbaceous fiber; 1 percent mineral content; slightly acid.

The organic material is more than 51 inches thick. It ranges from medium acid to neutral and is primarily herbaceous. Some pedons contain woody fragments 1 to 6 inches in diameter. The surface tier has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or has hue of N and value of 2 or 3. Fiber content is dominantly less than 5 percent when rubbed. In some pedons mineral content is as much as 10 percent. The subsurface and bottom tiers have hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3, or has hue of N and value of 2 or 3. They are primarily sapric material, but thin layers of hemic material with a combined thickness of less than 10 inches are in some pedons. Fiber content is dominantly less than 11 percent when rubbed. In some pedons mineral content is as much as 7 percent.

Markton series

The Markton series consists of deep, somewhat poorly drained soils. The permeability is rapid in the upper part of the solum and moderate in the lower part of the solum and the underlying material. These soils are on end moraines and formed in sandy deposits over loamy glacial till. Slopes range from 0 to 3 percent.

Markton soils are commonly adjacent to Crosier; Metea; Plainfield, loamy substratum; and Wawasee soils. Crosier soils are in the same setting as Markton soils, but have more clay in the upper part of the solum. Metea soils are browner in the lower part of the profile. Plainfield, loamy substratum, soils are browner throughout the profile and have more than 40 inches of sandy deposits over the loamy glacial till. Wawasee soils are browner in the lower part of the profile and have more clay in the upper part of the solum. Metea; Plainfield, loamy substratum; and Wawasee soils are on higher positions in the landscape.

Typical pedon of Markton sand, 0 to 3 percent slopes, in a cultivated field, 150 feet east and 200 feet north of the southwest corner, sec. 24, T. 32 N., R. 1 W.

Ap—0 to 11 inches; dark brown (10YR 3/3) sand, gray (10YR 6/1) dry; weak medium granular structure; very friable; many fine and very fine roots; medium acid; abrupt smooth boundary.

B1—11 to 26 inches; yellowish brown (10YR 5/6) sand; many medium distinct strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; very friable; common fine and very fine roots; common dark brown (10YR 3/3) soil material in root channels; slightly acid; abrupt wavy boundary.

IIB21t—26 to 30 inches; brown (10YR 5/3) loam; many medium distinct yellowish brown (10YR 5/6) and many medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films on faces of peds; about 5 percent gravel; neutral; abrupt wavy boundary.

IIB22tg—30 to 36 inches; light brownish gray (10YR 6/2) loam; many medium distinct yellowish brown (10YR 5/6) and brown (10YR 4/3) mottles; moderate medium subangular blocky structure; friable; thin discontinuous light brownish gray (10YR 6/2) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

IIC1g—36 to 40 inches; light brownish gray (10YR 6/2) loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; about 5 percent gravel; slight effervescence; mildly alkaline; clear irregular boundary.

IIC2g—40 to 55 inches; gray (10YR 6/1) loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; about 5 percent gravel; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC3—55 to 60 inches; brown (10YR 5/3) loam; many medium distinct gray (10YR 6/1) and few fine distinct yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; massive; friable; about 5 percent gravel; strong effervescence; mildly alkaline.

The solum is 24 to 40 inches thick. Coarse fragments in the lower part of the solum range from 0 to 15 percent by volume. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is sand or loamy sand. The B1 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is sand or loamy sand and ranges from neutral to medium acid. The IIB2t horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 6. It is sandy loam or loam, and reaction is neutral or slightly acid. The IIC horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4. Coarse fragments range from 0 to 15 percent by volume.

Maumee series

The Maumee series consists of deep, very poorly drained, rapidly permeable soils on outwash plains. These soils formed in sandy deposits. Slopes range from 0 to 2 percent.

Maumee soils are similar to Gilford and Newton soils and are commonly adjacent to Morocco and Watseka soils. Gilford soils have more clay in the upper part of the profile than do Maumee soils. Newton soils are more acid. Morocco soils have an ochric epipedon. Morocco and Watseka soils are browner in the upper part of the profile and are on slightly higher ridges and knolls.

Typical pedon of Maumee sand, in a cultivated field, 100 feet west and 200 feet south of the northeast corner, sec. 11, T. 33 N., R. 2 W.

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

A12—10 to 17 inches; very dark grayish brown (10YR 3/2) sand, dark gray (10YR 4/1) dry; common medium distinct brown (10YR 5/3) mottles; weak medium granular structure; very friable; few very fine roots; common black (10YR 2/1) crayfish channels; slightly acid; clear wavy boundary.

C1g—17 to 31 inches; dark gray (10YR 4/1) sand; many medium distinct grayish brown (10YR 5/2) mottles; weak medium granular structure; very friable; few very fine roots; common black (10YR 2/1) crayfish channels; slightly acid; clear wavy boundary.
C2—31 to 41 inches; dark grayish brown (10YR 4/2) sand; common medium distinct brown (10YR 5/3) mottles; weak medium granular structure; very friable; common black (10YR 2/1) crayfish channels; slighty acid; clear wavy boundary.
C3—41 to 49 inches; grayish brown (10YR 5/2) sand; many medium distinct yellowish brown (10YR 5/4) and few fine distinct strong brown (7.5YR 5/8) mottles; single grain; loose; few very dark grayish brown (10YR 3/2) crayfish channels; slightly acid; clear wavy boundary.
C4—49 to 60 inches; brown (10YR 5/3) sand; common fine prominent yellowish red (5YR 5/8) mottles; single grain; loose; slightly acid.

The A horizon has hue of 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. It is loamy sand, sand, mucky loamy sand, or mucky sand. The C horizon has hue of 10YR and value of 4 to 6. It has chroma of 1 or 2 in the upper part of the profile and chroma of 2 or 3 in the lower part. Reaction is slightly acid or neutral.

Maumee Variant

The Maumee Variant consists of deep, very poorly drained soils. The permeability is moderately slow to moderately rapid in the solum and rapid in the underlying material. These soils are on outwash plains and formed in sandy deposits. Slopes range from 0 to 2 percent.

Maumee Variant soils are similar to Gilford, Maumee, and Newton soils, and are commonly adjacent to Morocco soils. Gilford soils have more clay in the upper part of the profile than do Maumee Variant soils and do not have a cemented iron layer in the profile. Maumee and Newton soils do not have a cemented iron layer in the profile. Newton soils are more acid. Morocco soils have an ochric epipedon, are browner in the upper part of the profile, and do not have a cemented iron layer in the profile. They are on slightly higher ridges and knolls.

Typical pedon of Maumee Variant loamy sand, in a cultivated field, 2,415 feet east and 210 feet north of the center, sec. 2, T. 33 N., R. 2 W.

Ap—0 to 10 inches; dark brown (7.5YR 3/2) loamy sand, brown (7.5YR 4/2) dry; weak medium subangular blocky structure; very friable; 10 percent cemented iron fragments; common fine and very fine roots; slightly acid; abrupt wavy boundary.
B2m—10 to 15 inches; strong brown (7.5YR 5/6) iron layer; many medium distinct yellowish brown (10YR 5/8) mottles; strongly cemented; common fine and very fine roots; dark brown (7.5YR 3/2) loamy sand pore fillings; slightly acid; abrupt wavy boundary.
C1—15 to 24 inches; dark grayish brown (10YR 4/2) sand; many medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/4) mottles; massive; very friable; few fine and very fine roots; common dark gray (10YR 4/1) crayfish channels; few partially decomposed plant fibers; neutral; clear irregular boundary.
C2—24 to 39 inches; grayish brown (10YR 5/2) sand; common fine distinct strong brown (7.5YR 5/6) mottles; single grain; loose; common dark grayish brown (10YR 4/2) crayfish channels; neutral; gradual wavy boundary.
C3—39 to 60 inches; light brownish gray (10YR 6/2) sand; single grain; loose; neutral.

The solum is 12 to 20 inches thick. The cemented iron layer is 2 to 15 inches thick. The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. It is loamy sand, loamy fine sand, or fine sandy loam. The B2m horizon has hue of 5YR, 7.5YR, or 10YR; value of 5 or 6; and chroma of 6 to 8. It is slightly acid or medium acid. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. It is sand, loamy sand, or coarse sand. It is slightly acid or neutral in the upper part of the profile and neutral or mildly alkaline in the lower part.

Metea series

The Metea series consists of deep, well drained soils. The permeability is rapid in the upper part of the profile and moderate in the lower part. These soils are on end moraines and formed in sandy deposits over loamy glacial till. Slopes range from 1 to 4 percent. In Starke County, these soils have a slightly thicker, more acid solum than defined for the Metea series. This difference does not alter the usefulness or behavior of the soils.

Metea soils are similar to Plainfield, loamy substratum, soils and are commonly adjacent to Crosier, Markton, and Wawasee soils. Plainfield, loamy substratum, soils have more than 40 inches of sandy deposits over the loamy glacial till. Crosier soils have more clay in the upper part of the solum and are grayer throughout the profile. Markton soils are grayer in the lower part of the profile. Crosier and Markton soils are in lower areas. Wawasee soils have more clay in the upper part of the solum and are in the same setting as Metea soils.

Typical pedon of Metea loamy sand, 1 to 4 percent slopes, in a cultivated field, 480 feet east and 720 feet south of the center, sec. 1, T. 32 N., R. 1 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; common fine and very fine roots; strongly acid; abrupt smooth boundary.
B1—9 to 25 inches; yellowish brown (10YR 5/4) loamy sand; weak fine subangular blocky structure; very friable; 2 percent gravel; few fine and very fine roots; medium acid; abrupt wavy boundary.

B21t—25 to 32 inches; yellowish brown (10YR 5/6) fine sandy loam; moderate medium subangular blocky structure; friable; thin discontinuous yellowish brown (10YR 5/6) clay films on faces of peds; 1 percent gravel; medium acid; clear wavy boundary.
IIB22t—32 to 40 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium subangular blocky structure; friable; thin discontinuous yellowish brown (10YR 5/6) clay films on faces of peds; 1 percent gravel; strongly acid; clear wavy boundary.
IIB23t—40 to 45 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium subangular blocky structure; friable; thin discontinuous yellowish brown (10YR 5/6) clay films on faces of peds; 2 percent gravel; few yellowish red (5YR 5/8) accumulations; strongly acid; clear wavy boundary.
IIB31t—45 to 50 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; friable; thin discontinuous brown (10YR 4/3) clay films on faces of peds; 2 percent gravel; strongly acid; clear wavy boundary.
IIB32—50 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; 1 percent gravel; few yellowish red (5YR 5/8) iron stains; medium acid.

The solum is more than 60 inches thick. Coarse fragments in the lower part of the solum are less than 10 percent by volume. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is loamy sand or sand. The B1 horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is loamy sand or sand. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is fine sandy loam or sandy loam. The IIB2t horizon has hue of 10YR, value of 4 or 5, and chroma of 4. It is clay loam or sandy clay loam. The IIB3 horizon has hue of 10YR, value of 5, and chroma of 4 to 6.

Morocco series

The Morocco series consists of deep, somewhat poorly drained, rapidly permeable soils on outwash plains. These soils formed in sandy deposits. Slopes range from 0 to 2 percent.

Morocco soils are similar to Watseka soils and are commonly adjacent to Brems, Maumee, and Plainfield soils. Watseka soils have a mollic epipedon. Brems soils have gray mottles, but they are below a depth of 40 inches. Brems soils are on slightly higher ridges and knolls than Morocco soils. Maumee soils have a mollic epipedon and are grayer in the upper part of the profile. They are in wetter depressional areas. Plainfield soils are browner throughout the profile and are on higher ridges and knolls.

Typical pedon of Morocco loamy sand, in a cultivated field, 1,485 feet east and 250 feet south of the center, sec. 27, T. 33 N., R. 2 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common very fine roots; slightly acid; abrupt smooth boundary.
A2—8 to 13 inches; brown (10YR 5/3) sand; few fine distinct yellowish brown (10YR 5/8) and few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very friable; few very fine roots; medium acid; clear wavy boundary.
B2—13 to 26 inches; brownish yellow (10YR 6/8) sand; few fine distinct light brownish gray (10YR 6/2) and few medium distinct light gray (10YR 7/1) mottles; single grain; loose; few very fine roots; medium acid; clear wavy boundary.
C1—26 to 39 inches; pale brown (10YR 6/3) sand; few fine distinct yellowish brown (10YR 5/6) and few fine faint light gray (10YR 6/1) mottles; single grain; loose; medium acid; clear wavy boundary.
C2—39 to 45 inches; very pale brown (10YR 7/3) sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; medium acid; clear wavy boundary.
C3—45 to 60 inches; light gray (10YR 7/2) sand; few fine distinct yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 5/8) mottles; single grain; loose; medium acid.

The solum is 24 to 36 inches thick. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is sand or loamy sand. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. The B2 horizon has hue of 10YR, value to 5 to 7, and chroma of 1 to 8. It ranges from medium acid to very strongly acid. The C horizon has hue of 10YR, value of 5 to 7, and chroma of 1 to 6.

Napoleon series

The Napoleon series consists of deep, very poorly drained soils. The permeability is moderate or moderately rapid. These soils are on outwash plains, lake plains, and end moraines. They formed in organic deposits. Slopes range from 0 to 2 percent.

Napoleon soils are similar to Adrian, Edwards, Houghton, and Toto soils. Adrian soils formed in 16 to 50 inches of sapric muck over sand. Edwards soils formed in 16 to 50 inches of sapric muck over marl. Houghton soils formed in sapric muck that is more than 51 inches deep. Toto soils formed in 16 to 35 inches of sapric muck over coprogenous earth, marl, and sand.

Typical pedon of Napoleon muck, undrained, in a wooded area, 800 feet east and 400 feet south of the center, sec. 32, T. 33 N., R. 1 W.

O1—2 inches to 0; undecomposed leaves of pin oak, river birch, and silver maple; abrupt wavy boundary.
Oa—0 to 3 inches; very dark brown (10YR 2/2) broken face sapric material, dark brown (7.5YR 3/2)

rubbed; 30 percent fiber, 4 percent rubbed; moderate medium granular structure; very friable; many fine and very fine roots; mostly herbaceous fiber; extremely acid; abrupt wavy boundary.

Oe1—3 to 18 inches; dark brown (7.5YR 3/2) broken face and rubbed hemic material; 50 percent fiber, 20 percent rubbed; moderate thick platy structure; friable; many fine and very fine roots; mostly herbaceous fiber; extremely acid; clear wavy boundary.

Oe2—18 to 26 inches; very dark brown (10YR 2/2) broken face and rubbed hemic material; 70 percent fiber, 30 percent rubbed; moderate thick platy structure; friable; many very fine roots; mostly herbaceous fiber; extremely acid; clear wavy boundary.

Oe3—26 to 38 inches; dark brown (7.5YR 3/2) broken face and rubbed hemic material; 65 percent fiber, 30 percent rubbed; moderate medium platy structure; friable; few very fine roots; mostly herbaceous fiber; extremely acid; clear wavy boundary.

Oe4—38 to 60 inches; dark brown (7.5YR 3/2) broken face and rubbed hemic material; 40 percent fiber, 20 percent rubbed; massive; friable; few very fine roots; mostly herbaceous fiber; extremely acid.

The organic material is more than 51 inches thick. It is primarily herbaceous. Some pedons are up to 5 percent woody fragments. The surface tier has hue of 5YR, 7.5YR, or 10YR; value of 2 or 3; and chroma of 1 to 4, or has hue of N and value of 2 or 3. The subsurface and bottom tiers have hue of 5YR, 7.5YR, or 10YR; value of 2 to 5; and chroma of 2 to 4.

Newton series

The Newton series consists of deep, very poorly drained, rapidly permeable soils on outwash plains. These soils formed in sandy deposits. Slopes range from 0 to 2 percent.

Newton soils are similar to Gilford and Maumee soils and are commonly adjacent to Brems and Morocco soils. Gilford soils have more clay in the upper part of the profile and are less acid than Newton soils. Maumee soils also are less acid. Brems soils have an ochric epipedon and are browner throughout. They are on higher ridges and knolls. Morocco soils have an ochric epipedon and are browner in the upper part of the profile. They are on slightly higher ridges and knolls.

Typical pedon of Newton loamy sand, in a cultivated field, 270 feet west and 760 feet south of the northeast corner, sec. 33, T. 32 N., R. 2 W.

Ap—0 to 8 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak medium granular structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

A12—8 to 13 inches; black (10YR 2/1) loamy sand, gray (10YR 5/1) dry; few medium distinct brown (10YR 4/3) mottles; weak medium granular structure; very friable; few fine roots; strongly acid; clear irregular boundary.

A13—13 to 20 inches; very dark grayish brown (10YR 3/2) sand, gray (10YR 5/1) dry; few medium distinct brown (10YR 4/3) mottles; weak medium granular structure; very friable; few very fine roots; common black (10YR 2/1) crayfish channels; strongly acid; clear wavy boundary.

C1—20 to 33 inches; dark grayish brown (10YR 4/2) sand; common medium faint dark gray (10YR 4/1) mottles; single grain; loose; common black (10YR 2/1) crayfish channels; strongly acid; clear wavy boundary.

C2—33 to 45 inches; grayish brown (10YR 5/2) sand; common medium distinct dark gray (10YR 4/1), many coarse faint brown (10YR 5/3), and few fine distinct yellowish brown (10YR 5/4) mottles; single grain; loose; very strongly acid; clear wavy boundary.

C3—45 to 60 inches; grayish brown (10YR 5/2) sand; common medium faint gray (10YR 5/1) and few fine distinct yellowish brown (10YR 5/4) mottles; single grain; loose; very strongly acid.

The A horizon has hue of 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2.

Ormas series

The Ormas series consists of deep, well drained soils. The permeability is moderately rapid in the solum and rapid in the underlying material. These soils are on end moraines and formed in sandy deposits. Slopes range from 1 to 4 percent.

Ormas soils are commonly adjacent to Coloma, Metea, Ormas Variant, and Plainfield soils. Coloma soils have less clay in the upper part of the profile and have less gravel throughout the profile than do Ormas soils. Metea soils have more clay in the lower part of the profile. Coloma and Metea soils are in the same setting as Ormas soils. Ormas Variant soils are grayer in the lower part of the profile. They are in lower areas. Plainfield soils have less clay in the subsoil and less gravel throughout the profile. They are in the same setting as Ormas soils.

Typical pedon of Ormas sand, 1 to 4 percent slopes, in a cultivated field, 350 feet east and 2,000 feet south of the northwest corner, sec. 5, T. 32 N., R. 1 W.

Ap—0 to 9 inches, dark brown (7.5YR 4/2) sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; 1 percent gravel; many fine and very fine roots; medium acid; abrupt smooth boundary.

B21—9 to 28 inches; strong brown (7.5YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; 4 percent gravel; few fine and very fine roots; medium acid; clear wavy boundary.

IIB22t—28 to 35 inches; strong brown (7.5YR 5/6) sandy loam; moderate medium subangular blocky structure; friable; thin discontinuous strong brown (7.5YR 5/6) clay films on faces of peds; 11 percent gravel; few fine and very fine roots; slightly acid; abrupt wavy boundary.

IIB23t—35 to 45 inches; brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; thin discontinuous brown (7.5YR 4/4) clay films on faces of peds; 10 percent gravel; few fine and very fine roots; neutral; abrupt irregular boundary.

IIC—45 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; 35 percent gravel; strong effervescence; mildly alkaline.

The solum is 40 to 70 inches thick. Gravel content in the upper part of the solum ranges from 1 to 10 percent by volume. In the lower part of the solum it ranges from 6 to 30 percent by volume. The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. It is sand or loamy sand. The B2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand or loamy sand and is slightly acid or medium acid. The IIB2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 8. It is sandy clay loam, sandy loam, gravelly sandy clay loam, or gravelly sandy loam. It ranges from neutral to medium acid. The IIC horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. It is gravelly sand or gravelly coarse sand. Some pedons have strata of sand or coarse sand.

Ormas Variant

The Ormas Variant consists of deep, somewhat poorly drained soils. The permeability is moderately rapid in the solum and very rapid in the underlying material. These soils are on outwash plains and end moraines and formed in sandy deposits. Slopes range from 0 to 2 percent.

Ormas Variant soils are similar to Morocco soils and are commonly adjacent to Brems, Gilford, and Maumee soils. Morocco soils have gray mottles in the upper part of the solum and have less clay in the subsoil than do Ormas Variant soils. Brems soils have gray mottles, but they are at a depth of more than 40 inches. Brems soils have less clay in the subsoil and are on slightly higher ridges and knolls. Gilford and Maumee soils have a mollic epipedon and are grayer in the upper part of the profile. They are in wetter depressional areas.

Typical pedon of Ormas Variant loamy sand, in an area of Ormas Variant-Morocco loamy sands, 0 to 2 percent slopes, in a cultivated field, 2,100 feet east and 300 feet north of the southwest corner, sec. 20, T. 34 N., R. 2 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loamy sand, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; many very fine roots; slightly acid; abrupt smooth boundary.

A2—8 to 13 inches; brown (10YR 5/3) loamy sand; common fine distinct strong brown (7.5YR 5/6) and common medium faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; very friable; many very fine roots; slightly acid; clear wavy boundary.

B21—13 to 24 inches; yellowish brown (10YR 5/4) loamy sand; many medium distinct strong brown (7.5YR 5/8), few fine faint brown (10YR 5/3) and many fine prominent yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; very friable; few very fine roots; common brown (10YR 5/3) root channels; slightly acid; gradual wavy boundary.

B22—24 to 35 inches; yellowish brown (10YR 5/6) loamy sand; common medium distinct light brownish gray (10YR 6/2), many medium faint yellowish brown (10YR 5/4), and common fine distinct strong brown (7.5YR 5/8) mottles; weak medium granular structure; very friable; few very dark grayish brown (10YR 3/2) iron and manganese oxide accumulations at base of horizon; medium acid; clear wavy boundary.

B23tg—35 to 48 inches; gray (10YR 6/1) sandy loam; many medium distinct strong brown (7.5YR 5/8) and yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; thin discontinuous gray (10YR 6/1) clay films on faces of peds; 4 percent gravel; medium acid; abrupt wavy boundary.

C—48 to 60 inches; light yellowish brown (10YR 6/4) loamy sand; many medium faint light brownish gray (10YR 6/2) and pale brown (10YR 6/3) and many medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; 11 percent gravel; strongly acid.

The solum is 30 to 55 inches thick. Gravel content in the upper part of the solum is less than 5 percent by volume. In the lower part of the solum it is less than 20 percent by volume. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is sand or loamy sand. The B2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is sand or loamy sand and ranges from slightly acid to strongly acid. The Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 8. It is sandy loam, sandy clay loam, gravelly sandy loam, or gravelly sandy clay loam. Reaction is medium acid or strongly acid. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 6. It is gravelly sand, gravelly coarse sand, gravelly loamy sand, sand, coarse sand, or loamy sand. Some pedons have strata of fine sand or very fine sand. Reaction is medium acid or strongly acid.

Plainfield series

The Plainfield series consists of deep, excessively drained, rapidly permeable soils on outwash plains. The loamy substratum phase is well drained and is moderately permeable in the lower part of the profile. The wet substratum phase is moderately well drained. Plainfield soils formed in sandy deposits. Slopes range from 0 to 15 percent.

Plainfield soils are similar to Coloma soils and are commonly adjacent to Brems and Morocco soils. Coloma soils have thin, banded A&B horizons above a depth of 60 inches. Brems soils are grayer in the lower part of the profile and are in slightly lower areas than Plainfield soils. Morocco soils are grayer throughout the profile and are in lower areas.

Typical pedon of Plainfield sand, 1 to 8 percent slopes, in a cultivated field, 120 feet west and 800 feet south of the northeast corner, sec. 4, T. 32 N., R. 3 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine and very fine roots; medium acid; abrupt smooth boundary.

B21—7 to 16 inches; strong brown (7.5YR 5/8) sand; weak fine granular structure; very friable; common fine and very fine roots; medium acid; clear wavy boundary.

B22—16 to 24 inches; yellowish brown (10YR 5/8) sand; weak fine granular structure; very friable; common fine and very fine roots; medium acid; clear wavy boundary.

C1—24 to 32 inches; yellowish brown (10YR 5/6) sand; single grain; loose; few fine roots; strongly acid; gradual wavy boundary.

C2—32 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few small pebbles at 55 inches; medium acid.

The solum is 20 to 34 inches thick. The control section averages 70 percent sand, coarse sand, and very coarse sand. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is sand or loamy sand. The B horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. It ranges from medium acid to very strongly acid. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 4 to 8. It is sand or coarse sand. The C horizon of the wet substratum phase of this series has mottles. The loamy substratum phase of this series is loam in the lower part of the profile.

Prochaska series

The Prochaska series consists of deep, very poorly drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvial deposits. Slopes range from 0 to 2 percent.

Prochaska soils are similar to Craigmile soils and are commonly adjacent to Adrian, Algansee Variant, and Suman soils. Craigmile soils have more clay in the upper part of the profile than do Prochaska soils. Adrian soils formed in 16 to 50 inches of muck over sand and are in more depressional areas. Algansee Variant soils have an ochric epipedon, have more clay in the lower part of the profile, and are browner in the upper part of the profile. They are on slighty higher areas. Suman soils have more clay in the upper part of the profile. They are in the same setting as Prochaska soils.

Typical pedon of Prochaska loamy sand, occasionally flooded, in a cultivated field, 120 feet east and 2,300 feet south of the northwest corner, sec. 3, T. 32 N., R. 3 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; many fine and very fine roots; strongly acid; abrupt smooth boundary.

A12—9 to 12 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; few fine distinct brown (10YR 4/3) mottles; weak fine subangular blocky structure; very friable; many fine and very fine roots; medium acid; abrupt wavy boundary.

B21g—12 to 18 inches; dark gray (10YR 4/1) sand; many medium faint dark grayish brown (10YR 4/2) and common fine distinct strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; very friable; common fine and very fine roots; many thin black (10YR 2/1) lenses of sand and loamy sand; medium acid; abrupt wavy boundary.

B22g—18 to 24 inches; black (10YR 2/1) sand; many fine distinct dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; very friable; common fine and very fine roots; many reddish brown (5YR 4/4) and yellowish red (5YR 4/6) fillings of old root channels; medium acid; abrupt wavy boundary.

C1g—24 to 32 inches; gray (10YR 5/1) sand; many medium faint dark gray (10YR 4/1), common fine distinct yellowish brown (10YR 5/4), and few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; few very fine roots; many thin very dark gray (10YR 3/1) sand and loamy sand lenses; few thin black (N 2/0) lenses of sapric material; slightly acid; clear wavy boundary.

C2g—32 to 52 inches; grayish brown (10YR 5/2) coarse sand; many medium faint gray (10YR 5/1), common fine distinct yellowish brown (10YR 5/6), and few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; many thin black (N 2/0) lenses of sapric material; slightly acid; clear wavy boundary.

C3g—52 to 60 inches; grayish brown (10YR 5/2) sand; common medium faint gray (10YR 5/1), common medium distinct yellowish brown (10YR 5/4), and few fine distinct strong brown (7.5YR 5/8) mottles;

single grain; loose; few thin black (N 2/0) lenses of sapric material; few thin very dark grayish brown (10YR 3/2) sand lenses; neutral.

The solum is 20 to 36 inches thick. The A horizon has hue of 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. It is loamy sand, loamy fine sand, or sand. The B2g horizon has hue of 10YR, value of 2 to 6, and chroma of 1 or 2. It is sand, loamy sand, or loamy fine sand. It has thin lenses of muck, sand, and loamy sand with chroma of 0 to 2. It is slightly acid or medium acid. The C horizon has hue of 10YR, value of 5 to 7, and chroma of 1 to 3. It is sand, loamy sand, or coarse sand. It has thin lenses of muck, sand, and loamy sand with chroma of 0 to 2. It is medium acid to neutral to a depth of 40 inches and slightly acid or neutral below that.

Shoals Variant

The Shoals Variant consists of deep, somewhat poorly drained soils. The permeability is moderate in the loamy material and rapid in the sandy material. These soils are on high bottom lands on flood plains and formed in alluvium consisting of loamy sediment over sandy deposits. Slopes range from 0 to 2 percent.

Shoals Variant soils are commonly adjacent to Algansee, Craigmile, and Craigmile Variant soils. Algansee soils have less clay in the upper part of the profile than do Shoals Variant soils. They are in slightly lower areas. Craigmile soils have a mollic epipedon, are grayer in the upper part of the profile, and have less clay in the upper part of the profile. They are in wetter depressional areas. Craigmile Variant soils have less clay in the subsoil. They are in slightly lower areas.

Typical pedon of Shoals Variant loam, rarely flooded, in a cultivated field, 195 feet east and 1,140 feet north of the southwest corner, sec. 13, T. 33 N., R. 2 W.

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

B21tg—9 to 19 inches; dark grayish brown (10YR 4/2) sandy clay loam; many fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; few dark reddish brown (5YR 2.5/2) iron and manganese oxide accumulations; few very fine roots; few very dark grayish brown (10YR 3/2) worm casts and root channels; slightly acid; clear wavy boundary.

B22tg—19 to 25 inches; dark grayish brown (10YR 4/2) sandy clay loam; common fine faint grayish brown (10YR 5/2) and many fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; common dark reddish brown (5YR 2.5/2) iron and manganese oxide accumulations; few very fine roots; few very dark grayish brown (10YR 3/2) worm casts and root channels; neutral; gradual wavy boundary.

B23t—25 to 30 inches; strong brown (7.5YR 5/6) loam; many fine distinct grayish brown (10YR 5/2) and common fine distinct dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; friable; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; common dark reddish brown (5YR 2.5/2) iron and manganese oxide accumulations; few very fine roots; slightly acid; clear wavy boundary.

B24t—30 to 36 inches; strong brown (7.5YR 5/6) loam; few fine distinct reddish brown (5YR 4/3) and dark grayish brown (10YR 4/2), and many fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; slightly acid; abrupt irregular boundary.

B3—36 to 40 inches; strong brown (7.5YR 5/6) fine sandy loam; many medium distinct grayish brown (10YR 5/2) and few fine prominent yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; very friable; few thin strong brown (7.5YR 5/6) sandy clay loam lenses; neutral; clear wavy boundary.

C1g—40 to 43 inches; gray (10YR 5/1) loam; common medium distinct yellowish brown (10YR 5/4), common fine distinct strong brown (7.5YR 5/6), and few fine prominent reddish brown (5YR 4/4) mottles; massive; friable; many thin gray (10YR 5/1) silt loam lenses; neutral; abrupt wavy boundary.

IIC2—43 to 60 inches; grayish brown (10YR 5/2) fine sand; many medium faint brown (10YR 5/3) mottles; single grain; loose; few thin dark gray (10YR 4/1) and strong brown (7.5YR 5/6) loamy sand lenses; neutral.

The solum is 30 to 45 inches thick. The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is loam, silt loam, fine sandy loam, or sandy loam. The B2t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 6. It is clay loam, loam, or sandy clay loam and is neutral to medium acid. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is loam or fine sandy loam in the upper part and loamy sand, fine sand, sand, or coarse sand in the lower part. Most pedons have thin lenses of silt loam, loamy sand, and fine sandy loam. Reaction is slightly acid or neutral.

Suman series

The Suman series consists of deep, very poorly drained soils. The permeability is moderately slow in the solum and rapid in the underlying material. These soils are on flood plains and formed in alluvium consisting of loamy and silty sediment over sandy deposits. Slopes range from 0 to 2 percent.

Suman soils are similar to Craigmile soils and are commonly adjacent to Adrian, frequently flooded, and Prochaska soils. Craigmile soils have less clay in the upper part of the profile than do Suman soils. Adrian, frequently flooded, soils formed in 16 to 50 inches of muck over sand and are in more depressional areas. Prochaska soils have less clay in the upper part of the profile. They are in the same setting as Suman soils.

Typical pedon of Suman silt loam, frequently flooded, in a wooded area, 60 feet south and 1,240 feet east of the northwest corner, sec. 18, T. 34 N., R. 2 W.

A1—0 to 5 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many fine and very fine roots; neutral; abrupt smooth boundary.

A12—5 to 12 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; few fine distinct reddish brown (5YR 4/4) mottles; moderate medium granular structure; friable; many fine and very fine roots; slightly acid; abrupt wavy boundary.

B21g—12 to 17 inches; dark gray (10YR 4/1) silt loam; many medium prominent yellowish red (5YR 5/8) and many medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; many very fine roots; neutral; clear wavy boundary.

B22g—17 to 31 inches; dark gray (10YR 4/1) silty clay loam; few fine prominent reddish brown (5YR 5/4) and many medium prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; firm; thin lenses of dark gray (10YR 4/1) sand; neutral; abrupt wavy boundary.

IIC—31 to 60 inches; brown (10YR 5/3) sand; few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; common thin strata of very dark gray (10YR 3/1) sand; neutral.

The solum is 20 to 40 inches thick. The amount of gravel in the solum ranges from 0 to 5 percent. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2 or has hue of N and value of 2 or 3. It is silt loam, loam, silty clay loam, or clay loam. The B2g horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, clay loam, or silt loam. Most pedons have thin lenses of sand, fine sand, loamy fine sand, or fine sandy loam. It ranges from slightly acid to mildly alkaline. The IIC horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4. The amount of gravel ranges from 0 to 5 percent. Reaction is neutral or mildly alkaline.

Toto series

The Toto series consists of deep, very poorly drained soils. The permeability is moderately slow to slow in the organic material and coprogenous earth and rapid in the underlying sandy material. These soils are on outwash plains, lake plains, and end moraines. They formed in organic deposits over coprogenous earth, marl, and sand. Slopes range from 0 to 2 percent.

Toto soils are similar to Adrian, Edwards, Houghton, and Napoleon soils and are commonly adjacent to Maumee soils. Adrian soils formed in 16 to 50 inches of muck over sand. Edwards soils formed in 16 to 50 inches of muck over marl. Houghton and Napoleon soils formed in muck that is more than 51 inches deep. Maumee soils are sandy and are on slightly higher areas.

Typical pedon of Toto muck, drained, in a cultivated field, 580 feet west and 800 feet south of the center, sec. 34, T. 33 N., R. 2 W.

Oap—0 to 9 inches; black (N 2/0) broken face and rubbed sapric material; 26 percent fiber, 4 percent rubbed; weak medium granular structure; very friable; many very fine roots; mostly herbaceous fiber; 11 percent mineral content; neutral; abrupt smooth boundary.

Oa2—9 to 18 inches; black (N 2/0) broken face and rubbed sapric material; 18 percent fiber, 3 percent rubbed; moderate medium subangular blocky structure; friable; common very fine roots; mostly herbaceous fiber; 9 percent mineral content; neutral; abrupt wavy boundary.

Oa3—18 to 24 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; 26 percent fiber, 6 percent rubbed; moderate coarse subangular blocky structure; friable; few very fine roots; mostly herbaceous fiber; 5 percent mineral content; neutral; abrupt smooth boundary.

IILco—24 to 30 inches; very dark grayish brown (2.5Y 3/2) coprogenous earth; many fine prominent strong brown (7.5YR 5/6) mottles; moderate medium platy structure; friable; sodium pyrophosphate, extract is white (10YR 8/2); neutral; abrupt irregular boundary.

IIILca—30 to 38 inches; gray (5Y 6/1) marl; many fine prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) and common coarse distinct gray (N 5/0) mottles; massive; very friable; many partially decomposed plant fibers; common light gray (10YR 7/1) shell fragments; violent effervescence; moderately alkaline; abrupt irregular boundary.

IVC1g—38 to 48 inches; dark gray (10YR 4/1) sand; common fine distinct brown (10YR 5/3), many fine distinct strong brown (7.5YR 5/8), and common fine prominent yellowish red (5YR 5/6) mottles; single grain; loose; strong effervescence; moderately alkaline; clear wavy boundary.

IVC2—48 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; strong effervescence; moderately alkaline.

The organic material is 16 to 35 inches thick. It ranges from medium acid to neutral and is herbaceous. Some pedons contain woody fragments 1 to 4 inches in diameter. The surface tier has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or has hue of N and value of 2 or 3. Fiber content is dominantly less than 9 percent when rubbed. In some pedons mineral content is as much as 20 percent. The subsurface and bottom tiers have hue of 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. They are primarily sapric material, but thin layers of hemic material with a combined thickness of less than 6 inches are in some pedons. Fiber content is dominantly less than 12 percent when rubbed. In some pedons mineral content is as much as 25 percent. The IILco horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 or 4; and chroma of 2 to 4. It is neutral or mildly alkaline. The IIILca horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 1 to 6. It is mildly alkaline or moderately alkaline. The IVC horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 6. It ranges from neutral to moderately alkaline.

Watseka series

The Watseka series consists of deep, somewhat poorly drained, rapidly permeable soils on outwash plains. These soils formed in sandy deposits. Slopes range from 0 to 2 percent.

Watseka soils are similar to Morocco soils and are commonly adjacent to Brems and Maumee soils. Morocco soils have an ochric epipedon. Brems soils have an ochric epipedon and are browner in the solum than Watseka soils. They are on slightly higher ridges and knolls. Maumee soils are grayer in the upper part of the profile and are in lower areas.

Typical pedon of Watseka loamy sand, in a cultivated field, 2,280 feet east and 120 feet south of the northwest corner, sec. 31, T. 34 N., R. 1 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy sand, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; very friable; common very fine roots; neutral; abrupt smooth boundary.

A12—8 to 11 inches; very dark brown (10YR 2/2) loamy sand, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; very friable; common very fine roots; slightly acid; clear smooth boundary.

B1—11 to 16 inches; dark grayish brown (10YR 4/2) sand; common fine distinct yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very friable; few very fine roots; medium acid; clear wavy boundary.

B2—16 to 28 inches; brown (10YR 4/3) sand; many medium faint dark grayish brown (10YR 4/2) and many medium distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; few very dark grayish brown (10YR 3/2) crayfish channels; medium acid; clear wavy boundary.

C1—28 to 50 inches; light brownish gray (10YR 6/2) sand; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; single grain; loose; medium acid; gradual wavy boundary.

C2—50 to 60 inches; light brownish gray (10YR 6/2) sand; single grain; loose; slightly acid.

The solum is 24 to 32 inches thick. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loamy sand or sand. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is slightly acid or medium acid. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 1 to 3.

Wawasee series

The Wawasee series consists of deep, well drained, moderately permeable soils on end moraines. These soils formed in loamy glacial till. Slopes range from 1 to 8 percent.

Wawasee soils are commonly adjacent to Crosier, Markton, and Metea soils. Crosier soils are grayer throughout the profile and are in lower areas than Wawasee soils. Markton soils are grayer in the lower part of the profile and have less clay in the upper part of the solum. They are in lower areas. Metea soils have less clay in the upper part of the solum and are in the same setting as Wawasee soils.

Typical pedon of Wawasee fine sandy loam, 1 to 8 percent slopes, in a cultivated field, 550 feet east and 400 feet north of the center, sec. 12, T. 32 N., R. 1 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; 1 percent gravel; many fine and very fine roots; slightly acid; abrupt smooth boundary.

B21t—10 to 21 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; friable; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; 1 percent gravel; few fine and very fine roots; common dark grayish brown (10YR 4/2) worm casts and root channels; slightly acid; clear wavy boundary.

B22t—21 to 31 inches; yellowish brown (10YR 5/6) loam; moderate fine subangular blocky structure;

friable; medium discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; 1 percent gravel; few fine and very fine roots; few dark grayish brown (10YR 4/2) worm casts and root channels; slightly acid; abrupt wavy boundary.

C—31 to 60 inches; brown (10YR 5/3) loam; massive; friable; 1 percent gravel; few dark grayish brown (10YR 4/2) worm casts; strong effervescence; mildly alkaline.

The solum is 28 to 40 inches thick. Content of coarse fragments throughout the solum is less than 10 percent by volume. The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is fine sandy loam or sandy loam. Some pedons have an A2 horizon. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is sandy clay loam or loam and is neutral or slightly acid. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is loam or sandy loam.

formation of the soils

This section describes the major factors of soil formation and explains their importance in the formation of the soils in the county.

factors of soil formation

Soil is produced by soil-forming processes acting on geological material. Some of these processes are unknown, but usually the characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

These factors of soil formation are so closely interrelated that few generalizations can be made about the effects of any one factor unless conditions are specified for the other four. In general, however, climate and plant and animal life, especially plants, are active factors of soil formation. They act on the parent material that has accumulated through weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. It may be long or short, but some time is always required for differentiation of soil horizons. Usually a long time is required for the development of distinct horizons.

parent material

Parent material is the unconsolidated mass from which a soil is formed. It determines the limits of the chemical and mineralogical composition of the soil.

Glaciers covered the area that is now Starke County from about 10,000 to 12,000 years ago, and the parent materials of the soils were deposited by glaciers or by melt water from the glaciers. Some of these materials were later reworked and redeposited by water and wind. Although the materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Starke County were glacial till, outwash deposits, alluvium, and organic material.

Most soils in Starke County formed in Wisconsin glacial outwash and glacial till. A thin layer of outwash was deposited over the till in many small areas. Along streams, many soils formed in recent alluvium over sandy material. Muck soils formed in many depressional areas throughout the county.

The preglacial landscape was mainly shale and, to a small extent, limestone and dolomite. The bedrock under most of the county is Devonian age shale, but in the south-central part of the county it is Devonian age limestone and dolomite. Several glaciers have covered the area, but the Wisconsin Glacier is the most recent and has had the most influence on the formation of the soils. The thickness of the glacial drift is as much as 200 feet (*6*).

Glacial till was laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes that are mixed together. Many of the small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Starke County is calcareous. Its texture is loam and sandy loam. An example of soils formed in glacial till are those of the Crosier series. These soils typically are medium and moderately fine textured and have well-developed structure.

Outwash material was deposited by running water from melting glaciers. These deposits generally consist of layers of particles of similar size. The size of the particles in each layer varies according to the speed of the stream of water that carried them. Where and when the water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay can be carried by slower water. The Plainfield soils on nearly level slopes, for example, formed in outwash material.

Alluvial material was deposited by floodwaters of present streams in recent time. This material ranges in texture, again depending on the speed of the water that deposited it. The alluvium along a swift stream like the upper part of the Yellow River in Starke County is, therefore, coarser than that deposited along a slower stream like the Kankakee River. Examples of alluvial soils are the Algansee and Suman soils.

Organic material is made up of plant remains. When the glaciers receded, water was left standing in lakes and depressions in outwash plains and till plains. Grasses and sedges grew around the edges of these lakes, and as they died their remains fell to the bottom. Because of the wetness, however, the plant remains did not decompose. White-cedar and other water-tolerant trees later grew in these areas. As these trees died, their residues added to the organic accumulation. In this way, the lakes eventually became filled with organic material and developed into areas of peat. In some of these areas the plant remains subsequently decomposed to muck. In other areas the material has changed little since deposition. Soils of the Houghton series are an example of soils formed in organic material.

plant and animal life

Plants have been the principal organism influencing the soils in Starke County, but bacteria, fungi, earthworms, and human civilization have also had an effect. The chief contribution of plants and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kind of plants that grew on the soil. The remains of these plants accumulate in the surface, decay, and eventually become organic matter. As they decay, roots of the plants leave channels for downward movement of water through the soil and also add organic matter. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The native vegetation in Starke County was mainly grass vegetation in the bottom lands and deciduous forests in the uplands. The soils that developed under dominantly grass vegetation generally have more total accumulated organic matter than soils that developed under dominantly forest vegetation. The Maumee and Gilford soils, for example, were covered with grasses and contain considerable amounts of organic matter. Differences in natural soil drainage and minor changes in parent material affect the composition of the forest. In general, the well drained upland soils, such as the Wawasee and Metea soils, were mainly covered with sugar maple and hickory. The Plainfield soils were covered with black oak and white oak. The wet soils primarily supported pin oak and tamarack.

climate

Climate is important in the formation of soils for many reasons. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering of minerals and the transporting of soil materials. Climate, through its influence on temperatures, determines the rate of chemical reactions in the soil.

The climate in Starke County is cool and humid and was presumably similar when the soils formed. The soils in Starke County differ from soils formed in a dry, warm climate and from those formed in a hot, moist climate. The climate is uniform throughout Starke County, although its effect is modified locally by runoff and proximity to large bodies of water. Therefore, the differences between the soils within the county are, only to a minor extent, the results of the differences in climate.

relief

Relief, or topography, has a marked influence on the soils of Starke County through its influence on natural drainage, erosion, plant cover, and soil temperature. Slopes in the county generally range from 0 to 15 percent in grade. Some small areas are steeper. Natural soil drainage ranges from excessively drained on the ridgetops to very poorly drained in the depressions.

Relief influences the formation of soils by affecting water runoff and drainage. Drainage, in turn, affects aeration of the soil. Runoff of water is greatest on the steeper slopes, but low areas can be temporarily ponded. Water and air move freely through soils that are excessively drained but slowly through soils that are very poorly drained or saturated. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are bright as a result of oxidation; poorly aerated soils are usually dull gray and mottled. The Plainfield soils are examples of well aerated, excessively drained soils. The Newton soils are examples of poorly aerated, very poorly drained soils.

Intermediate between the excessively drained and very poorly drained soils are the poorly drained, somewhat poorly drained, moderately well drained, well drained, and somewhat excessively drained soils.

time

Time, usually a long time, is required for the formation of distinct horizons in the soil from parent material. The differences in the length of time that parent materials have been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Starke County range from young to mature. The glacial deposits from which many of the soils formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop. Recent alluvial sediment, however, has not been in place long enough for soils with distinct horizons to develop.

The Algansee soils are examples of young soils formed in alluvial material. The Ormas and Crosier soils are examples of older soils that reflect the slow leaching of lime. The upper horizons of these soils once had about as much lime as their underlying C horizons have today.

processes of soil formation

Several processes have been involved in the formation of the soils in Starke County. These processes are the accumulation of organic matter; the solution, transfer, and removal of calcium carbonates and bases; and the liberation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all the soils. The organic matter content of some soils is low, but that of others is high. Generally, the soils that have the most organic matter, like soils of the Gilford or Suman series, have a thick, black surface layer.

Carbonates and bases have been leached from the upper horizons of nearly all the soils in the county. Leaching is generally believed to precede the translocation of silicate clay minerals. Most all of the carbonates and some of the bases have been leached from the A and B horizons of excessively drained and well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching of wet soils is slow because of the seasonal high water table or because water moves slowly through such soils.

Clay particles accumulate in pores and other voids and form films on the surface, along which water moves. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils. Soils of the Wawasee series are examples of soils in which translocated silicate clays have accumulated in the B2t horizon in the form of clay films.

The reduction and transfer of iron, or gleying, has occurred in most of the very poorly drained, poorly drained, and somewhat poorly drained soils in Starke County. In the naturally wet soils this process has been significant in horizon differentiation. The gray color of the subsoil indicates the redistribution of iron oxides. The reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower horizons or completely out of the profile. Mottles, which are in many horizons, indicate segregation of iron.

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glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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

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.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

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.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

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.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms. The Lco horizon is a limnic layer that contains many fecal pellets.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainage, subsurface. Removal of excess ground water through buried drains installed within the soil profile. The drains collect the water and convey it to a gravity or pump outlet.

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.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial 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.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green-manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. 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 rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal (end), lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

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

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

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.

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.

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.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Strip grazing. An intensive form of rotation grazing.

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.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal (end) moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. 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 loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Underlying material. The part of the soil below the solum. (See substratum).

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Based on data recorded in the period 1951-74 at Plymouth, Ind.]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	32.9	15.8	24.4	59	-16	12	1.89	1.01	2.59	5	8.8
February---	37.1	19.2	28.2	62	-11	14	1.70	.90	2.34	5	8.4
March------	47.1	27.3	37.2	80	2	98	2.51	1.78	3.17	7	5.4
April------	62.3	38.4	50.4	85	18	318	4.12	2.68	5.43	9	1.3
May--------	73.5	48.0	60.8	92	27	645	3.43	2.07	4.65	7	.0
June-------	83.4	57.2	70.2	98	39	909	4.17	2.80	5.41	7	.0
July-------	86.1	60.9	73.5	98	44	1,039	4.37	2.70	5.86	7	.0
August-----	84.6	58.8	71.7	96	41	983	3.14	1.75	4.26	5	.0
September--	78.4	51.8	65.1	95	31	753	3.23	1.49	4.64	6	.0
October----	66.4	41.7	54.0	87	23	438	3.22	1.22	4.82	6	.2
November---	49.5	31.1	40.3	74	9	96	2.53	1.66	3.30	6	3.5
December---	37.1	21.7	29.4	64	-10	29	2.47	1.01	3.65	6	8.7
Yearly Average--	61.5	39.3	50.4	---	---	---	---	---	---	---	---
Extreme--	---	---	---	99	-17	---	---	---	---	---	---
Total----	---	---	---	---	---	5,334	36.78	31.14	42.17	76	36.3

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Based on data recorded in the period 1951-74 at Plymouth, Ind.]

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 19	May 12	May 20
2 years in 10 later than--	April 15	May 5	May 15
5 years in 10 later than--	April 9	April 23	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	October 13	October 9	September 21
2 years in 10 earlier than--	October 19	October 11	September 26
5 years in 10 earlier than--	October 31	October 20	October 5

TABLE 3.--GROWING SEASON LENGTH

[Based on data recorded in the period 1951-74 at Plymouth, Ind.]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	185	156	139
8 years in 10	192	164	144
5 years in 10	204	180	152
2 years in 10	216	195	160
1 year in 10	223	203	164

TABLE 4.--POTENTIALS AND LIMITATIONS OF MAP UNITS ON THE GENERAL SOIL MAP FOR SPECIFIED USES

Map unit	Extent of area	Cultivated farm crops	Specialty crops	Woodland	Urban uses	Intensive recreation areas	Extensive recreation areas
	Pct						
1. Maumee-Gilford-Watseka-----------	37	Fair: wetness, ponding.	Fair: wetness, ponding.	Fair: wetness, ponding.	Poor: wetness, ponding.	Poor: wetness, ponding.	Fair: wetness, ponding.
2. Houghton-Adrian----	4	Fair: wetness, ponding.	Good.	Fair: wetness, ponding.	Poor: wetness, ponding.	Poor: wetness, ponding.	Good.
3. Plainfield-Brems-Morocco-----------	38	Poor: droughty, soil blowing.	Fair: droughty.	Fair: droughty.	Fair: poor filter, wetness.	Fair: too sandy.	Fair: too sandy.
4. Craigmile-Suman----	4	Fair: wetness, flooding.	Fair: wetness, flooding.	Fair: wetness, flooding.	Poor: wetness, flooding.	Poor: wetness, flooding.	Good.
5. Algansee-----------	3	Good.	Fair: wetness, droughty.	Fair: wetness.	Poor: wetness, flooding.	Fair: wetness, flooding.	Good.
6. Craigmile----------	4	Fair: wetness, flooding.	Fair: wetness, flooding.	Fair: wetness, flooding.	Poor: wetness, flooding.	Poor: wetness, flooding.	Good.
7. Prochaska-Adrian---	7	Fair: ponding, flooding.	Fair: ponding, flooding.	Fair: ponding, flooding.	Poor: ponding, flooding.	Poor: ponding, flooding.	Good.
8. Markton-Metea-Crosier-----------	3	Fair: droughty, wetness.	Fair: droughty.	Fair: droughty.	Poor: wetness.	Fair: too sandy, wetness.	Fair: too sandy, wetness.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Adrian muck, drained	9,087	4.5
Af	Adrian muck, frequently flooded	1,005	0.5
An	Algansee fine sandy loam, occasionally flooded	3,098	1.5
As	Algansee Variant sand, occasionally flooded	1,114	0.6
BeA	Brems sand, 0 to 3 percent slopes	18,884	9.4
ChB	Coloma sand, 0 to 6 percent slopes	1,257	0.6
Co	Craigmile fine sandy loam, frequently flooded	8,688	4.3
Cp	Craigmile Variant fine sandy loam, rarely flooded	1,852	0.9
CrA	Crosier fine sandy loam, 0 to 3 percent slopes	685	0.3
Ed	Edwards muck, drained	832	0.4
Gf	Gilford sandy loam	10,082	5.0
Ho	Houghton muck, drained	8,364	4.2
MdA	Markton sand, 0 to 3 percent slopes	3,289	1.6
Me	Maumee sand	27,026	13.4
Mh	Maumee mucky sand	2,774	1.4
Mn	Maumee Variant loamy sand	1,207	0.6
MpB	Metea loamy sand, 1 to 4 percent slopes	1,003	0.5
Mr	Morocco loamy sand	22,151	11.1
Na	Napoleon muck, undrained	306	0.2
Nf	Newton loamy sand	5,224	2.6
OrB	Ormas sand, 1 to 4 percent slopes	768	0.4
OvA	Ormas Variant-Morocco loamy sands, 0 to 2 percent slopes	2,547	1.3
PlA	Plainfield sand, 0 to 1 percent slopes	5,310	2.7
PlB	Plainfield sand, 1 to 8 percent slopes	14,072	7.0
PlC	Plainfield sand, 8 to 15 percent slopes	2,158	1.1
PtA	Plainfield sand, wet substratum, 0 to 3 percent slopes	15,269	7.6
PvB	Plainfield sand, loamy substratum, 1 to 8 percent slopes	571	0.3
Px	Prochaska loamy sand, occasionally flooded	6,912	3.5
Sh	Shoals Variant loam, rarely flooded	1,705	0.9
So	Suman silt loam, frequently flooded	2,388	1.2
To	Toto muck, drained	2,643	1.3
Ud	Udorthents gravelly sand	112	0.1
Wk	Watseka loamy sand	14,696	7.3
WwB	Wawasee fine sandy loam, 1 to 8 percent slopes	511	0.3
	Water	2,730	1.4
	Total	200,320	100.0

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Ad: Adrian	90	23	---	2.4	4.8
Af: Adrian	85	22	---	2.2	4.4
An: Algansee	80	27	36	3.0	6.0
As: Algansee Variant	80	27	36	3.4	6.8
BeA: Brems	70	24	32	2.3	4.6
ChB: Coloma	70	21	---	2.0	4.0
Co: Craigmile	110	38	45	3.5	7.0
Cp: Craigmile Variant	90	33	45	3.5	7.0
CrA: Crosier	115	40	52	3.8	7.6
Ed: Edwards	95	34	---	3.0	6.0
Gf: Gilford	120	44	54	4.0	8.0
Ho: Houghton	110	34	---	3.0	6.0
MdA: Markton	85	32	44	3.5	7.0
Me, Mh: Maumee	110	38	50	3.6	7.2
Mn: Maumee Variant	105	36	46	3.5	7.0
MpB: Metea	85	30	42	2.8	5.6
Mr: Morocco	75	26	34	2.6	5.2
Na: Napoleon	---	---	---	---	---
Nf: Newton	100	35	45	3.3	6.6
OrB: Ormas	65	23	32	2.3	4.6
OvA: Ormas Variant-Morocco	80	27	36	3.0	6.0

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
PlA, PlB, PlC------------- Plainfield	---	---	---	2.0	4.0
PtA---------------------- Plainfield	65	21	30	2.1	4.2
PvB---------------------- Plainfield	65	20	29	2.5	5.0
Px----------------------- Prochaska	100	35	45	3.4	6.8
Sh----------------------- Shoals Variant	125	44	53	4.1	8.2
So----------------------- Suman	120	44	54	4.6	9.2
To----------------------- Toto	85	22	---	2.4	4.8
Ud**. Udorthents					
Wk----------------------- Watseka	85	28	37	3.4	6.8
WwB---------------------- Wawasee	105	37	47	3.4	6.8

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	---	---	---	---
II	14,835	511	14,324	---
III	83,874	1,003	64,860	18,011
IV	76,923	---	18,791	58,132
V	---	---	---	---
VI	21,846	---	306	21,540
VII	112	---	---	112
VIII	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
Ad: Adrian	4w	Slight	Severe	Severe	Severe	White ash	51	
						Red maple	51	
						Quaking aspen	56	
						Black willow	---	
						Silver maple	76	
Af: Adrian	3w	Slight	Severe	Severe	Severe	Red maple	51	Red maple, quaking aspen, eastern cottonwood.
						Silver maple	76	
						White ash	51	
						Quaking aspen	56	
						Tamarack	45	
						River birch	45	
						Eastern cottonwood	86	
						Pin oak	60	
						Northern white-cedar	27	
An: Algansee	3s	Slight	Slight	Moderate	Slight	Quaking aspen	60	Eastern cottonwood, American sycamore.
						Silver maple	---	
						Swamp white oak	---	
						White ash	---	
						Sugar maple	---	
						Northern pin oak	---	
						American sycamore	---	
						Common hackberry	---	
						Red maple	---	
As: Algansee Variant	3s	Slight	Slight	Severe	Slight	Quaking aspen	55	American sycamore, eastern cottonwood, quaking aspen, pin oak.
						Silver maple	76	
						Pin oak	80	
						American sycamore	80	
						Common hackberry	35	
						Red maple	51	
						Eastern cottonwood	90	
BeA: Brems	3s	Slight	Slight	Severe	Slight	Northern red oak	70	Eastern white pine, red pine, jack pine.
						Red pine	72	
						Eastern white pine	65	
						Jack pine	70	
ChB: Coloma	3s	Slight	Slight	Moderate	Slight	Northern red oak	70	Eastern white pine, red pine.
						White oak	70	
Co: Craigmile	2w	Slight	Severe	Severe	Severe	Red maple	72	Eastern white pine, white ash, red maple, American sycamore, pin oak.
						Silver maple	95	
						White ash	72	
						American elm	70	
						Eastern cottonwood	100	
						American sycamore	90	
						Pin oak	90	
Cp: Craigmile Variant	3w	Slight	Slight	Slight	Slight	Pin oak	80	Red maple, pin oak, white oak, yellow-poplar, American sycamore, eastern white pine.
						Eastern cottonwood	90	
						White oak	65	
						Northern red oak	65	
						Black walnut	65	
						Butternut	55	
						Honeylocust	70	
						American sycamore	90	
						River birch	51	
CrA: Crosier	3o	Slight	Slight	Slight	Slight	White oak	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak	85	
						Yellow-poplar	85	
						Northern red oak	75	

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi- nation symbol	Management concerns: Erosion hazard	Management concerns: Equip- ment limita- tion	Management concerns: Seedling mortal- ity	Management concerns: Wind- throw hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Ed------------------ Edwards	4w	Slight	Severe	Severe	Severe	White ash-----------	51	
						Red maple-----------	51	
						Quaking aspen-------	56	
Gf------------------ Gilford	4w	Slight	Severe	Severe	Severe	Pin oak-------------	70	Eastern white pine, white ash, eastern cottonwood.
						Eastern white pine--	55	
						Bigtooth aspen------	70	
						Red maple-----------	60	
Ho------------------ Houghton	4w	Slight	Severe	Severe	Severe	White ash-----------	51	
						Red maple-----------	51	
						Quaking aspen-------	56	
						Black willow--------	---	
						Silver maple--------	76	
MdA----------------- Markton	3s	Slight	Slight	Severe	Slight	White oak-----------	80	Eastern white pine, Austrian pine, red pine, black oak, white oak.
						Black oak-----------	70	
						Quaking aspen-------	70	
						Eastern cottonwood--	90	
						Red maple-----------	50	
Me, Mh-------------- Maumee	4w	Slight	Severe	Slight	Severe	Pin oak-------------	70	Eastern white pine, pin oak, eastern cottonwood.
						Eastern white pine--	55	
						Bigtooth aspen------	70	
						Silver maple--------	---	
Mn------------------ Maumee Variant	4w	Slight	Severe	Severe	Severe	Pin oak-------------	70	Eastern white pine, silver maple, eastern cottonwood.
						Silver maple--------	66	
						Eastern cottonwood--	80	
						Quaking aspen-------	50	
						Red maple-----------	45	
						American sycamore---	80	
MpB----------------- Metea	2s	Slight	Slight	Moderate	Slight	White oak-----------	80	Eastern white pine, red pine, yellow-poplar, black walnut.
						Yellow-poplar-------	86	
						Eastern white pine--	75	
						Red pine------------	75	
Mr------------------ Morocco	3o	Slight	Slight	Slight	Slight	Northern red oak----	70	Eastern white pine, red maple, American sycamore.
						Pin oak-------------	85	
						Eastern white pine--	65	
Na------------------ Napoleon	3w	Slight	Severe	Severe	Severe	Red maple-----------	56	
						Silver maple--------	---	
						White ash-----------	---	
						Quaking aspen-------	---	
						Tamarack------------	---	
						Black ash-----------	---	
Nf------------------ Newton	4w	Slight	Severe	Severe	Severe	Pin oak-------------	70	Eastern white pine, pin oak, eastern cottonwood.
						Eastern white pine--	55	
						Eastern cottonwood--	70	
OrB----------------- Ormas	3s	Slight	Slight	Severe	Slight	White oak-----------	70	Eastern white pine, red pine, yellow-poplar, black walnut.
						Yellow-poplar-------	---	
						Eastern white pine--	---	
						Red pine------------	78	
OvA*:								
Ormas Variant-----	3s	Slight	Slight	Moderate	Slight	Black oak-----------	70	Eastern white pine, eastern cottonwood.
						White oak-----------	65	
						Pin oak-------------	80	
						Sassafras-----------	30	
						Eastern cottonwood--	90	
						Northern red oak----	51	
Morocco-----------	3o	Slight	Slight	Slight	Slight	Northern red oak----	70	Eastern white pine, red maple, American sycamore.
						Pin oak-------------	85	
						Eastern white pine--	65	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
PlA, PlB, PlC: Plainfield	3s	Slight	Slight	Severe	Slight	Black oak	70	Red pine, eastern white pine, jack pine.
						White oak	65	
						Black cherry	---	
						Scarlet oak	68	
						Northern red oak	---	
PtA: Plainfield	3s	Slight	Slight	Severe	Slight	Black oak	70	Red pine, Austrian pine, jack pine, eastern white pine.
						White oak	65	
						Sassafras	30	
						Black cherry	40	
PvB: Plainfield	3s	Slight	Slight	Severe	Slight	Black oak	70	Red pine, eastern white pine, jack pine.
						White oak	65	
						Black cherry	---	
						Scarlet oak	68	
						Northern red oak	---	
Px: Prochaska	3w	Slight	Severe	Severe	Severe	Pin oak	76	Eastern cottonwood, silver maple, red maple, quaking aspen, eastern cottonwood.
						River birch	46	
						Red maple	50	
						Quaking aspen	55	
						Silver maple	70	
						Eastern cottonwood	86	
Sh: Shoals Variant	2o	Slight	Slight	Slight	Slight	Pin oak	80	Red maple, pin oak, white oak, yellow-poplar, American sycamore, eastern white pine.
						Eastern cottonwood	90	
						White oak	65	
						Northern red oak	65	
						Black walnut	65	
						Butternut	55	
						Honeylocust	70	
						American sycamore	90	
						River birch	51	
So: Suman	2w	Slight	Severe	Severe	Severe	Pin oak	85	Eastern white pine, red maple, white ash.
						Red maple	---	
						Swamp white oak	---	
						White ash	---	
To: Toto	3w	Slight	Severe	Severe	Severe	Red maple	51	Red maple, quaking aspen, eastern cottonwood.
						Silver maple	76	
						Quaking aspen	56	
						Eastern cottonwood	86	
						River birch	45	
						Pin oak	60	
						Tamarack	41	
						Northern white-cedar	27	
Wk: Watseka	---	---	---	---	---	---	---	Eastern white pine, red pine.
WwB: Wawasee	1o	Slight	Slight	Slight	Slight	White oak	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar	98	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ad: Adrian	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Black willow, golden willow.	Imperial Carolina poplar.
Af: Adrian	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
An: Algansee	---	Amur privet, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
As: Algansee Variant	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir, Austrian pine.	Norway spruce	Pin oak, eastern white pine.
BeA: Brems	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---
ChB: Coloma	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---
Co: Craigmile	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
Cp: Craigmile Variant	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Austrian pine, white fir, blue spruce, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
CrA Crosier	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, blue spruce, northern white-cedar, Washington hawthorn, white fir.	Norway spruce	Eastern white pine, pin oak.
Ed Edwards	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
Gf Gilford	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, northern white-cedar, Washington hawthorn, blue spruce, white fir, Austrian pine.	Eastern white pine	Pin oak.
Ho Houghton	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
MdA Markton	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Austrian pine, white fir, blue spruce, Washington hawthorn.	Norway spruce	Pin oak, eastern white pine.
Me, Mh Maumee	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Mn Maumee Variant	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
MpB Metea	Siberian peashrub	Eastern redcedar, radiant crabapple, lilac, Washington hawthorn, Amur honeysuckle, autumn-olive, Tatarian honeysuckle.	Red pine, jack pine, Austrian pine.	Eastern white pine	---
Mr Morocco	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Na. Napoleon					
Nf----------------- Newton	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
OrB---------------- Ormas	Siberian peashrub	Eastern redcedar, lilac, radiant crabapple, autumn-olive, Washington hawthorn, Amur honeysuckle, Tatarian honeysuckle.	Red pine, Austrian pine, jack pine.	Eastern white pine	---
OvA*: Ormas Variant----	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, Austrian pine, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
Morocco----------	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
PlA, PlB, PlC----- Plainfield	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Red pine, Austrian pine, jack pine.	Eastern white pine	---
PtA---------------- Plainfield	Siberian peashrub	Eastern redcedar, radiant crabapple, lilac, autumn-olive, Washington hawthorn, Amur honeysuckle, Tatarian honeysuckle.	Red pine, jack pine, Austrian pine.	Eastern white pine	---
PvB---------------- Plainfield	Siberian peashrub	Eastern redcedar, lilac, Washington hawthorn, autumn-olive, Amur honeysuckle, Tatarian honeysuckle, radiant crabapple.	Red pine, Austrian pine, jack pine.	Eastern white pine	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Px: Prochaska	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
Sh: Shoals Variant	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir, Austrian pine.	Norway spruce	Pin oak, eastern white pine.
So: Suman	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
To: Toto	Common ninebark, whitebelle honeysuckle.	Silky dogwood, Amur honeysuckle, Amur privet, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
Ud*. Udorthents					
Wk: Watseka	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
WwB: Wawasee	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ad------------------ Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
Af------------------ Adrian	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: flooding, ponding, excess humus.
An------------------ Algansee	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: flooding, wetness.
As------------------ Algansee Variant	Severe: flooding, wetness, too sandy.	Severe: too sandy.	Severe: too sandy, wetness.	Severe: too sandy.	Moderate: wetness, droughty, flooding.
BeA----------------- Brems	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
ChB----------------- Coloma	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
Co------------------ Craigmile	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
Cp------------------ Craigmile Variant	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
CrA----------------- Crosier	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Ed------------------ Edwards	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
Gf------------------ Gilford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ho------------------ Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
MdA----------------- Markton	Severe: wetness, too sandy.	Severe: too sandy.	Severe: too sandy, wetness.	Severe: too sandy.	Moderate: wetness, droughty, too sandy.
Me, Mh-------------- Maumee	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: ponding.
Mn------------------ Maumee Variant	Severe: ponding, cemented pan.	Severe: ponding, cemented pan.	Severe: ponding, cemented pan.	Severe: ponding.	Severe: ponding, thin layer.
MpB----------------- Metea	Slight-----------	Slight-----------	Moderate: slope.	Slight------------	Moderate: droughty.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Mr: Morocco	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Na: Napoleon	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
Nf: Newton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
OrB: Ormas	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
OvA*:					
Ormas Variant	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Morocco	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
PlA, PlB: Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
PlC: Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
PtA, PvB: Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
Px: Prochaska	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Sh: Shoals Variant	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
So: Suman	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
To: Toto	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Ud*. Udorthents					
Wk: Watseka	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
WwB: Wawasee	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ad, Af------------- Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
An----------------- Algansee	Poor	Fair	Fair	Poor	Poor	Fair	Fair	Fair	Poor	Fair.
As----------------- Algansee Variant	Poor	Poor	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
BeA---------------- Brems	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Poor	Poor	Poor.
ChB---------------- Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
Co----------------- Craigmile	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Cp----------------- Craigmile Variant	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
CrA---------------- Crosier	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ed----------------- Edwards	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gf----------------- Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Ho----------------- Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
MdA---------------- Markton	Poor	Poor	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
Me, Mh------------- Maumee	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Mn----------------- Maumee Variant	Fair	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
MpB---------------- Metea	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Mr----------------- Morocco	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor.
Na----------------- Napoleon	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
Nf----------------- Newton	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
OrB---------------- Ormas	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
OvA*: Ormas Variant-----	Poor	Fair	Good	Good	Good	Fair	Very poor.	Fair	Good	Poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
OvA*:										
Morocco-----------	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor.
PlA, PlB----------- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
PlC---------------- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
PtA---------------- Plainfield	Poor	Poor	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
PvB---------------- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Px----------------- Prochaska	Poor	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
Sh----------------- Shoals Variant	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
So----------------- Suman	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
To----------------- Toto	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ud*. Udorthents										
Wk----------------- Watseka	Fair	Fair	Good	Good	Good	Fair	Poor	Fair	Good	Poor.
WwB---------------- Wawasee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ad----------------- Adrian	Severe: ponding, cutbanks cave, excess humus.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: excess humus, ponding.
Af----------------- Adrian	Severe: cutbanks cave, ponding, excess humus.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, excess humus.
An----------------- Algansee	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Moderate: flooding, wetness.
As----------------- Algansee Variant	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, droughty, flooding.
BeA---------------- Brems	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
ChB---------------- Coloma	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty, too sandy.
Co----------------- Craigmile	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
Cp----------------- Craigmile Variant	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
CrA---------------- Crosier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Ed----------------- Edwards	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action, low strength.	Severe: excess humus, ponding.
Gf----------------- Gilford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
Ho----------------- Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: excess humus, ponding.
MdA---------------- Markton	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty, too sandy.
Me, Mh------------- Maumee	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Mn----------------- Maumee Variant	Severe: cutbanks cave, ponding, cemented pan.	Severe: ponding.	Severe: ponding, cemented pan.	Severe: ponding.	Severe: ponding.	Severe: ponding, thin layer.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MpB: Metea	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
Mr: Morocco	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Na: Napoleon	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: too acid, ponding, excess humus.
Nf: Newton	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
OrB: Ormas	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: droughty, too sandy.
OvA*:						
Ormas Variant	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
Morocco	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
PlA: Plainfield	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
PlB: Plainfield	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
PlC: Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
PtA: Plainfield	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Severe: droughty.
PvB: Plainfield	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Px: Prochaska	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding.
Sh: Shoals Variant	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, frost action.	Moderate: wetness.
So: Suman	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
To: Toto	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Ud*. Udorthents						
Wk: Watseka	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
WwB: Wawasee	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ad------------------ Adrian	Severe: ponding, poor filter.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Severe: ponding, seepage.	Poor: ponding, excess humus.
Af------------------ Adrian	Severe: flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: seepage, flooding, ponding.	Poor: ponding, excess humus.
An------------------ Algansee	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
As------------------ Algansee Variant	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
BeA----------------- Brems	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
ChB----------------- Coloma	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Co------------------ Craigmile	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
Cp------------------ Craigmile Variant	Severe: wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
CrA----------------- Crosier	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ed------------------ Edwards	Severe: ponding, percs slowly.	Severe: ponding, seepage, excess humus.	Severe: ponding.	Severe: ponding, seepage.	Poor: ponding, excess humus.
Gf------------------ Gilford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Ho------------------ Houghton	Severe: ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
MdA----------------- Markton	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Me, Mh: Maumee	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, too sandy, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Mn: Maumee Variant	Severe: ponding, poor filter, cemented pan.	Severe: seepage, ponding, cemented pan.	Severe: seepage, too sandy, ponding.	Severe: seepage, ponding, cemented pan.	Poor: seepage, ponding, area reclaim.
MpB: Metea	Moderate: percs slowly.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Mr: Morocco	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, too sandy, wetness.	Severe: seepage, wetness.	Poor: too sandy, wetness, seepage.
Na: Napoleon	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
Nf: Newton	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, seepage, ponding.
OrB: Ormas	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
OvA*:					
Ormas Variant	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Morocco	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, too sandy, wetness.	Severe: seepage, wetness.	Poor: too sandy, wetness, seepage.
PlA, PlB: Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PlC: Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PtA: Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
PvB: Plainfield	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Px: Prochaska	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Sh------------------ Shoals Variant	Severe: wetness.	Severe: seepage, flooding, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
So------------------ Suman	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, seepage, too sandy.
To------------------ Toto	Severe: ponding, percs slowly, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Ud*. Udorthents					
Wk------------------ Watseka	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness, seepage.
WwB----------------- Wawasee	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ad: Adrian	Poor: wetness, low strength.	Probable	Improbable: too sandy.	Poor: wetness, excess humus.
Af: Adrian	Poor: wetness, low strength.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
An: Algansee	Fair: wetness.	Probable	Improbable: too sandy.	Good.
As: Algansee Variant	Fair: wetness.	Improbable: thin layer.	Improbable: excess fines.	Poor: too sandy.
BeA: Brems	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
ChB: Coloma	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Co: Craigmile	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Cp: Craigmile Variant	Fair: wetness.	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
CrA: Crosier	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Ed: Edwards	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
Gf: Gilford	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Ho: Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
MdA: Markton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Me, Mh: Maumee	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too sandy.
Mn: Maumee Variant	Poor: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim, wetness.
MpB: Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy.
Mr: Morocco	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
Na: Napoleon	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness, too acid.
Nf: Newton	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OrB: Ormas	Good	Probable	Probable	Fair: too sandy, small stones.
OvA*:				
Ormas Variant	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Morocco	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
PlA, PlB, PlC, PtA: Plainfield	Good	Probable	Improbable: too sandy.	Poor: too sandy.
PvB: Plainfield	Good	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
Px: Prochaska	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Sh: Shoals Variant	Fair: wetness.	Probable	Improbable: too sandy.	Good.
So: Suman	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
To: Toto	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
Ud*. Udorthents				
Wk: Watseka	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
WwB: Wawasee	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Grassed waterways
Ad: Adrian	Severe: seepage.	Severe: seepage, ponding, excess humus.	Severe: slow refill, cutbanks cave.	Ponding, frost action, subsides.	Ponding, soil blowing.	Wetness.
Af: Adrian	Severe: seepage.	Severe: ponding, excess humus.	Severe: cutbanks cave.	Ponding, flooding, subsides.	Flooding, ponding, soil blowing.	Wetness.
An: Algansee	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, droughty.
As: Algansee Variant	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action.	Wetness, droughty, fast intake.	Wetness, droughty.
BeA: Brems	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Droughty, rooting depth.
ChB: Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Co: Craigmile	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, frost action.	Ponding	Wetness, erodes easily.
Cp: Craigmile Variant	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, soil blowing, rooting depth.	Wetness, rooting depth.
CrA: Crosier	Slight	Severe: piping, wetness.	Severe: slow refill.	Frost action	Wetness, soil blowing.	Wetness.
Ed: Edwards	Severe: seepage.	Severe: ponding.	Severe: slow refill.	Frost action, ponding, subsides.	Ponding, soil blowing.	Wetness.
Gf: Gilford	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Wetness.
Ho: Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Soil blowing, ponding.	Wetness.
MdA: Markton	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action	Wetness, droughty, fast intake.	Wetness, droughty.
Me, Mh: Maumee	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
Mn: Maumee Variant	Severe: seepage, cemented pan.	Severe: seepage, piping, ponding.	Severe: cutbanks cave, slow refill.	Ponding, cemented pan, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty, cemented pan.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
MpB---------------- Metea	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Mr----------------- Morocco	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Droughty, fast intake, wetness.	Wetness, droughty.
Na----------------- Napoleon	Severe: seepage.	Severe: excess humus, wetness.	Moderate: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing, too acid.	Wetness.
Nf----------------- Newton	Severe: seepage.	Severe: piping, seepage, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Fast intake, droughty, ponding.	Wetness, droughty.
OrB---------------- Ormas	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
OvA*:						
Ormas Variant----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, droughty.
Morocco----------	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Droughty, fast intake, wetness.	Wetness, droughty.
PlA, PlB---------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
PlC---------------- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty, slope.
PtA---------------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
PvB---------------- Plainfield	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
Px----------------- Prochaska	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
Sh----------------- Shoals Variant	Moderate: seepage.	Severe: wetness.	Severe: cutbanks cave.	Frost action---	Wetness---------	Wetness, erodes easily.
So----------------- Suman	Severe: seepage.	Severe: seepage, wetness, piping.	Severe: cutbanks cave, slow refill.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness.
To----------------- Toto	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, subsides.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
Ud*. Udorthents						

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
Wk----------------- Watseka	Severe: seepage.	Severe: piping, seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, droughty.
WwB---------------- Wawasee	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Soil blowing, slope.	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ad: Adrian	0-36	Sapric material	Pt	A-8	---	---	---	---	---	---	---
	36-60	Sand, loamy sand, fine sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
Af: Adrian	0-34	Sapric material	Pt	A-8	0-1	---	---	---	---	---	---
	34-60	Sand	SP	A-3	0	100	95-100	75-90	1-4	---	NP
An: Algansee	0-12	Very fine sandy loam, fine sandy loam.	SM	A-2-4, A-4	0	100	100	60-80	30-50	---	NP
	12-60	Stratified sand to loam.	SM, SP-SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
As: Algansee Variant	0-9	Sand	SM, SP-SM	A-3, A-2-4, A-1-b	0	100	95-100	45-75	5-15	---	NP
	9-29	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2-4, A-3, A-1-b	0	100	95-100	45-80	5-35	---	NP
	29-60	Sandy loam, silt loam, loam.	SM, SC, ML, CL	A-4, A-6, A-2	0	100	95-100	65-95	30-80	15-30	NP-15
BeA: Brems	0-8	Sand	SM, SP-SM	A-2-4, A-3	0	100	85-100	50-85	5-15	---	NP
	8-44	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-25	---	NP
	44-60	Sand, fine sand, loamy sand.	SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-10	---	NP
ChB: Coloma	0-10	Sand	SP, SM, SP-SM	A-2, A-3	0-10	85-100	85-100	50-70	2-15	---	NP
	10-60	Stratified sand to loamy sand.	SP, SM, SP-SM	A-2, A-3, A-4	0-10	85-100	85-100	50-100	2-40	---	NP
Co: Craigmile	0-12	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0	100	95-100	60-80	30-55	<20	NP-6
	12-25	Fine sandy loam, loam, silt loam.	ML, CL, SM, SC	A-4	0	100	95-100	65-95	40-80	<25	3-8
	25-60	Loamy sand, sand	SM, SP-SM, SP	A-3, A-2	0	95-100	90-100	50-75	3-20	---	NP
Cp: Craigmile Variant	0-9	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0	100	95-100	65-95	30-55	<25	NP-5
	9-31	Fine sandy loam, sandy loam, sandy clay loam.	SM, SM-SC, ML	A-4, A-2-4	0	100	95-100	70-95	30-75	20-35	NP-10
	31-60	Loamy fine sand, sand, fine sand.	SM, SP, SP-SM	A-3, A-2-4	0	95-100	85-100	50-80	3-25	---	NP
CrA: Crosier	0-9	Fine sandy loam	SM, SC, SM-SC	A-2, A-4	0	100	95-100	60-70	30-40	20-30	3-10
	9-30	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-95	85-95	75-90	60-70	33-47	15-26
	30-60	Loam, sandy loam	CL, ML	A-4, A-6	0-3	85-90	80-90	70-85	50-60	25-35	2-12
Ed: Edwards	0-22	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	22-60	Marl	---	---	0	100	95-100	80-90	60-80	---	---
Gf: Gilford	0-15	Sandy loam	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	15-34	Sandy loam, fine sandy loam.	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	20-35	15-30	NP-8
	34-60	Loamy sand, sand	SM, SP, SP-SM	A-3, A-1-b, A-2-4	0	90-100	85-100	18-60	3-20	---	NP
Ho: Houghton	0-60	Sapric material	Pt	A-8	0	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
MdA--------------- Markton	0-11	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	100	95-100	45-75	5-15	---	NP
	11-26	Sand, loamy sand	SP-SM, SM	A-2-4, A-1-b, A-3	0	100	95-100	45-75	5-30	---	NP
	26-36	Sandy loam, loam	ML, CL-ML, SM, SM-SC	A-4, A-2-4	0	95-100	95-100	60-95	30-70	18-25	NP-7
	36-60	Loam-------------	ML, CL-ML	A-4	0	95-100	95-100	80-95	55-75	14-21	NP-6
Me---------------- Maumee	0-17	Sand-------------	SP-SM, SP, SM	A-2-4, A-3, A-2-4	0	95-100	90-100	50-75	3-15	<30	NP
	17-60	Sand, loamy fine sand.	SP, SP-SM, SM	A-1-b, A-3, A-2-4	0	85-100	75-95	35-70	3-25	<30	NP
Mh---------------- Maumee	0-10	Mucky sand-------	SM	A-2-4	0	95-100	90-100	50-75	15-30	<30	NP-5
	10-60	Sand, loamy fine sand.	SP, SP-SM, SM	A-1-b, A-3, A-2-4	0	85-100	75-95	35-70	3-25	<30	NP
Mn---------------- Maumee Variant	0-10	Loamy sand-------	SM, SM-SC	A-2-4	0	100	95-100	50-80	15-35	<20	NP-5
	10-15	Cemented---------	---	---	---	---	---	---	---	---	---
	15-60	Sand, loamy sand, coarse sand.	SP-SM, SM, SP	A-3, A-2-4, A-1	0	95-100	85-100	40-75	1-20	---	NP
MpB--------------- Metea	0-9	Loamy sand-------	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	9-25	Loamy sand, loamy fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	25-32	Sandy loam, fine sandy loam.	SM-SC, SM	A-4, A-2-4	0	90-100	90-95	75-95	30-65	<25	NP-7
	32-60	Loam, clay loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	85-95	85-95	75-90	45-75	25-35	5-15
Mr---------------- Morocco	0-8	Loamy sand-------	SM, SM-SC	A-2-4	0	100	100	50-85	15-35	<20	NP-5
	8-60	Fine sand, sand	SM, SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-25	---	NP
Na---------------- Napoleon	0-3	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	3-60	Hemic material---	Pt	A-8	0	---	---	---	---	---	---
Nf---------------- Newton	0-20	Loamy sand, sand	SM, SM-SC	A-2-4	0	100	100	50-75	15-30	<20	NP-5
	20-60	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-2-4, A-3	0	100	100	50-75	5-25	---	NP
OrB--------------- Ormas	0-9	Sand-------------	SM	A-2-4, A-3	0	95-100	95-100	50-75	15-30	---	NP
	9-28	Sand, loamy sand	SW-SM, SM, SP-SM	A-2-4, A-1-b	0	95-100	90-100	45-70	10-20	---	NP
	28-45	Sandy loam, sandy clay loam, gravelly sandy loam.	SM-SC, SM, GM-GC	A-2-4, A-4, A-2-6	0	80-95	70-95	40-70	20-40	<35	NP-15
	45-60	Gravelly sand, gravelly coarse sand.	SP, SP-SM	A-3, A-1-b, A-2-4	0	60-80	55-80	30-55	3-12	---	NP
OvA*: Ormas Variant---	0-8	Loamy sand-------	SM	A-2-4	0	100	95-100	50-75	15-30	---	NP
	8-35	Sand, loamy sand	SM, SP-SM, SW-SM	A-3, A-2-4, A-1-b	0	100	95-100	45-75	5-30	---	NP
	35-48	Sandy loam, sandy clay loam, gravelly sandy loam.	SM, SM-SC, SC	A-2, A-2-4, A-2-6, A-4	0	90-95	80-95	45-70	25-50	<35	NP-15
	48-60	Loamy sand, gravelly sand, sand.	SP, SP-SM, SM	A-1, A-3, A-1-b, A-2-4	0	90-95	75-95	40-60	1-15	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
OvA*:											
Morocco----------	0-9	Loamy sand-------	SM, SM-SC	A-2-4	0	100	100	50-85	15-35	<20	NP-5
	9-60	Fine sand, sand--	SM, SP-SM	A-3, A-2-4	0	100	80-100	50-85	5-25	---	NP
PlA, PlB, PlC---- Plainfield	0-7	Sand-------------	SP-SM, SM, SP	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	---	NP
	7-24	Sand-------------	SP	A-3, A-1, A-2	0	75-100	75-100	40-70	1-4	---	NP
	24-60	Sand, coarse sand	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
PtA-------------- Plainfield	0-8	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	45-75	5-15	---	NP
	8-60	Sand-------------	SP, SP-SM	A-3, A-1-b, A-2-4	0	95-100	85-100	40-70	1-12	---	NP
PvB-------------- Plainfield	0-10	Sand-------------	SP, SP-SM, SM	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	---	NP
	10-55	Sand-------------	SP, SP-SM, SM	A-2, A-3	0	95-100	75-85	50-70	3-15	---	NP
	55-60	Loam-------------	CL, CL-ML	A-4, A-6	0-5	85-100	80-95	60-90	50-75	25-40	7-16
Px--------------- Prochaska	0-12	Loamy sand-------	SM	A-2	0	100	95-100	50-80	15-35	---	NP
	12-24	Sand, loamy sand, loamy fine sand.	SP-SM, SM	A-3, A-2	0	95-100	90-100	50-80	5-30	---	NP
	24-60	Sand, coarse sand, loamy sand.	SP, SP-SM, SM	A-3, A-1, A-2	0	95-100	90-100	45-70	2-15	---	NP
Sh--------------- Shoals Variant	0-9	Loam-------------	CL-ML, CL	A-4, A-6	0	100	95-100	70-95	60-80	20-35	5-15
	9-43	Sandy clay loam, loam, fine sandy loam.	CL	A-6, A-7, A-4	0	100	95-100	85-95	70-80	20-45	7-25
	43-60	Fine sand, sand, coarse sand.	SP, SM, SP-SM	A-3, A-2-4, A-1	0	95-100	85-100	40-75	1-20	---	NP
So--------------- Suman	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	90-100	75-95	60-85	20-35	5-15
	12-31	Clay loam, silty clay loam, silt loam.	CL	A-6, A-7	0	100	90-100	80-95	60-90	35-50	15-30
	31-60	Sand, coarse sand	SM, SP-SM	A-3, A-2-4, A-1-b	0	100	90-100	40-75	5-25	---	NP
To--------------- Toto	0-24	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	24-30	Coprogenous earth	OH, OL	A-8	0	---	---	---	---	---	---
	30-38	Marl-------------	OL	A-4	0	100	95-100	80-90	60-80	---	NP
	38-60	Sand-------------	SM, SP-SM	A-3, A-2-4, A-1-b	0	95-100	95-100	45-70	5-15	---	NP
Ud*. Udorthents											
Wk--------------- Watseka	0-11	Loamy sand-------	SM, SM-SC	A-2	0	100	95-100	80-100	17-35	<25	NP-5
	11-60	Sand-------------	SP, SP-SM	A-3, A-2	0	100	90-100	60-80	3-15	<20	NP-4
WwB-------------- Wawasee	0-10	Fine sandy loam	SM, SM-SC	A-2-4, A-4	0	90-95	85-95	80-95	30-50	<25	NP-6
	10-31	Loam, sandy clay loam.	CL, SC	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	31-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	75-95	70-95	50-90	25-66	20-30	4-12

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Ad	0-36	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.8	---	----	---	3	55-75
Adrian	36-60	2-10	1.40-1.75	6.0-20	0.03-0.08	5.6-8.4	Low	----			
Af	0-34	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.3	---	----	---	3	55-75
Adrian	34-60	1-4	1.40-1.75	6.0-20	0.05-0.07	6.1-7.3	Low	0.15			
An	0-12	5-15	1.35-1.50	2.0-6.0	0.12-0.14	5.6-7.3	Low	0.17	5	3	1-4
Algansee	12-60	0-18	1.40-1.65	6.0-20	0.05-0.07	5.6-7.8	Low	0.17			
As	0-9	2-6	1.45-1.65	6.0-20	0.07-0.09	5.1-7.3	Low	0.17	5	1	.5-2
Algansee Variant	9-29	1-7	1.50-1.70	6.0-20	0.06-0.11	5.6-7.3	Low	0.17			
	29-60	10-20	1.40-1.60	2.0-6.0	0.11-0.22	6.1-7.3	Low	0.28			
BeA	0-8	2-6	1.50-1.65	6.0-20	0.07-0.09	5.1-6.5	Low	0.17	5	1	.5-1
Brems	8-44	2-6	1.60-1.75	6.0-20	0.05-0.08	4.5-6.0	Low	0.17			
	44-60	2-6	1.60-1.75	6.0-20	0.05-0.07	5.1-6.5	Low	0.17			
ChB	0-10	1-9	1.35-1.65	6.0-20	0.06-0.09	5.1-6.0	Low	0.15	5	1	<1
Coloma	10-60	1-10	1.50-1.65	6.0-20	0.03-0.08	5.1-6.5	Low	0.15			
Co	0-12	5-15	1.50-1.70	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	5	3	3-5
Craigmile	12-25	5-18	1.35-1.60	2.0-6.0	0.15-0.22	6.1-7.3	Low	0.37			
	25-60	2-10	1.60-1.75	6.0-20	0.05-0.10	6.6-7.8	Low	0.15			
Cp	0-9	5-15	1.50-1.70	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	5	3	1-3
Craigmile	9-31	10-17	1.40-1.65	2.0-6.0	0.12-0.18	6.1-7.3	Low	0.28			
Variant	31-60	2-13	1.60-1.75	6.0-20	0.05-0.10	6.1-7.3	Low	0.15			
CrA	0-9	5-15	1.35-1.50	0.6-2.0	0.13-0.15	5.6-7.3	Low	0.24	5	3	1-3
Crosier	9-30	20-33	1.40-1.60	0.2-0.6	0.15-0.19	5.1-7.3	Moderate	0.32			
	30-60	10-20	1.40-1.60	0.2-0.6	0.10-0.19	6.1-8.4	Low	0.32			
Ed	0-22	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.8	---	----	---	3	55-75
Edwards	22-60	---	---	---	---	7.4-8.4	---	----			
Gf	0-15	10-20	1.50-1.70	2.0-6.0	0.13-0.15	5.6-7.3	Low	0.20	4	3	2-4
Gilford	15-34	8-17	1.60-1.80	2.0-6.0	0.12-0.14	5.6-7.3	Low	0.20			
	34-60	3-12	1.70-1.90	6.0-20	0.05-0.08	6.6-8.4	Low	0.15			
Ho	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	---	----	---	3	>70
Houghton											
MdA	0-11	2-6	1.45-1.60	6.0-20	0.07-0.09	5.6-7.3	Low	0.15	5	1	1-3
Markton	11-26	2-8	1.50-1.70	6.0-20	0.06-0.11	5.6-7.3	Low	0.17			
	26-36	12-20	1.50-1.70	0.6-2.0	0.12-0.19	6.1-7.3	Low	0.28			
	36-60	8-16	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.28			
Me	0-17	2-10	1.60-1.75	6.0-20	0.10-0.12	6.1-7.3	Low	0.17	5	1	2-4
Maumee	17-60	2-10	1.60-1.75	6.0-20	0.05-0.07	6.1-8.4	Low	0.17			
Mh	0-10	2-10	1.00-1.30	6.0-20	0.15-0.18	6.1-7.3	Low	0.17	5	2	8-14
Maumee	10-60	2-10	1.60-1.75	6.0-20	0.05-0.07	6.1-8.4	Low	0.17			
Mn	0-10	3-9	1.45-1.60	6.0-20	0.10-0.12	5.6-7.3	Low	0.17	5	2	2-4
Maumee Variant	10-15	---	---	0.2-6.0	0.03-0.05	5.6-6.5	Low	----			
	15-60	1-7	1.60-1.75	6.0-20	0.04-0.10	6.1-7.8	Low	0.15			
MpB	0-9	3-8	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low	0.17	5	2	.5-2
Metea	9-25	2-10	1.50-1.70	6.0-20	0.06-0.11	5.1-7.3	Low	0.17			
	25-32	15-18	1.50-1.70	0.6-2.0	0.12-0.17	5.1-7.3	Low	0.32			
	32-60	18-35	1.40-1.65	0.6-2.0	0.15-0.19	5.1-8.4	Moderate	0.32			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
Mr	0-8	1-6	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low	0.17	5	2	.5-2
Morocco	8-60	1-6	1.50-1.70	6.0-20	0.05-0.07	4.5-6.0	Low	0.17			
Na	0-3	---	0.30-0.40	0.2-6.0	0.35-0.45	<4.5	---	---	2	2	---
Napoleon	3-60	---	0.10-0.20	0.6-6.0	0.45-0.55	<4.5	---	---			
Nf	0-20	3-7	1.45-1.60	6.0-20	0.10-0.12	5.1-6.0	Low	0.17	5	2	2-4
Newton	20-60	2-7	1.60-1.75	6.0-20	0.05-0.07	4.5-5.5	Low	0.17			
OrB	0-9	5-12	1.40-1.60	2.0-6.0	0.07-0.12	5.6-7.3	Low	0.17	5	2	1-3
Ormas	9-28	3-10	1.45-1.60	2.0-6.0	0.06-0.11	5.6-6.5	Low	0.17			
	28-45	10-25	1.50-1.70	2.0-6.0	0.12-0.14	5.1-7.3	Low	0.32			
	45-60	1-8	1.55-1.70	>20	0.03-0.05	7.4-8.4	Low	0.15			
OvA*:											
Ormas Variant	0-8	3-10	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low	0.17	5	2	.5-2
	8-35	2-8	1.50-1.70	6.0-20	0.06-0.11	5.1-6.5	Low	0.17			
	35-48	12-20	1.50-1.60	2.0-6.0	0.10-0.18	5.1-6.0	Low	0.17			
	48-60	1-10	1.60-1.75	>20	0.03-0.07	5.1-6.0	Low	0.17			
Morocco	0-9	1-6	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low	0.17	5	2	.5-2
	9-60	1-6	1.50-1.70	6.0-20	0.05-0.07	4.5-6.0	Low	0.17			
PlA, PlB, PlC	0-7	2-9	1.35-1.65	6.0-20	0.04-0.09	4.5-7.3	Low	0.17	5	1	<1
Plainfield	7-24	1-4	1.50-1.65	6.0-20	0.04-0.07	4.5-6.5	Low	0.17			
	24-60	1-4	1.50-1.75	6.0-20	0.04-0.07	4.5-6.5	Low	0.17			
PtA	0-8	2-5	1.50-1.65	6.0-20	0.07-0.09	4.5-7.3	Low	0.17	5	1	<1
Plainfield	8-60	1-4	1.60-1.75	6.0-20	0.04-0.08	4.5-6.0	Low	0.17			
PvB	0-10	3-9	1.35-1.65	6.0-20	0.04-0.09	4.5-7.3	Low	0.17	5	1	<1
Plainfield	10-55	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-6.0	Low	0.17			
	55-80	15-27	1.60-1.70	0.6-2.0	0.13-0.18	6.6-7.8	Low	0.32			
Px	0-12	3-8	1.40-1.60	6.0-20	0.10-0.12	5.1-7.3	Low	0.17	5	2	2-5
Prochaska	12-24	2-10	1.50-1.75	6.0-20	0.04-0.09	5.6-7.3	Low	0.17			
	24-60	1-8	1.50-1.75	6.0-20	0.02-0.06	5.6-7.3	Low	0.17			
Sh	0-9	10-22	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.37	5	5	2-4
Shoals Variant	9-43	18-30	1.35-1.60	0.6-2.0	0.15-0.19	5.6-7.3	Low	0.37			
	43-60	1-7	1.60-1.75	6.0-20	0.04-0.07	6.1-7.3	Low	0.15			
So	0-12	10-20	1.30-1.45	0.6-2.0	0.20-0.24	6.1-7.8	Low	0.32	5	6	4-8
Suman	12-31	20-32	1.40-1.60	0.2-0.6	0.17-0.20	6.1-7.8	Moderate	0.32			
	31-60	3-10	1.60-1.75	6.0-20	0.04-0.09	6.1-7.8	Low	0.10			
To	0-24	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.3	---	---	---	3	55-75
Toto	24-30	---	0.50-1.20	0.06-0.2	0.18-0.24	6.6-7.8	---	---			
	30-38	---	---	---	---	7.4-8.4	---	---			
	38-60	1-4	1.50-1.65	6.0-20	0.05-0.07	6.6-8.4	Low	0.15			
Ud*.											
Udorthents											
Wk	0-11	8-13	1.35-1.55	6.0-20	0.10-0.12	6.1-7.3	Low	0.17	5	2	1-3
Watseka	11-60	1-10	1.70-2.00	6.0-20	0.05-0.10	5.1-7.3	Low	0.17			
WwB	0-10	10-18	1.20-1.40	0.6-2.0	0.13-0.15	6.1-7.3	Low	0.28	5	3	1-3
Wawasee	10-31	18-27	1.50-1.70	0.6-2.0	0.12-0.18	6.1-7.3	Low	0.28			
	31-60	12-18	1.50-1.70	0.6-2.0	0.11-0.18	6.6-8.4	Low	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[See text for definition of terms. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ad Adrian	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
Af Adrian	A/D	Frequent	Long	Oct-Jun	+3-0.5	Apparent	Oct-Jun	>60	---	High	High	Moderate.
An Algansee	B	Occasional	Very brief	Nov-May	1.0-2.0	Apparent	Nov-May	>60	---	Moderate	Low	Low.
As Algansee Variant	B	Occasional	Very brief to brief.	Nov-May	1.0-2.0	Apparent	Nov-May	>60	---	High	Moderate	Moderate.
BeA Brems	A	None	---	---	2.0-4.0	Apparent	Jan-Apr	>60	---	Low	Low	High.
ChB Coloma	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Co Craigmile	B/D	Frequent	Brief to long.	Nov-Jun	+1-1.0	Apparent	Oct-Jun	>60	---	High	High	Moderate.
Cp Craigmile Variant	B	Rare	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	Moderate	Moderate.
CrA Crosier	C	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	High	Low.
Ed Edwards	B/D	None	---	---	+1-0.5	Apparent	Sep-Jun	>60	---	High	High	Low.
Gf Gilford	B/D	None	---	---	+.5-1.0	Apparent	Dec-May	>60	---	High	High	Moderate.
Ho Houghton	A/D	None	---	---	+-1.0	Apparent	Sep-Jun	>60	---	High	High	Low.
MdA Markton	C	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	Moderate	Low.
Me, Mh Maumee	A/D	None	---	---	+.5-1.0	Apparent	Dec-May	>60	---	Moderate	High	Moderate.
Mn Maumee Variant	A/D	None	---	---	+.5-1.0	Apparent	Dec-May	>60	---	Moderate	High	Moderate.
MpB Metea	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Mr Morocco	B	None	---	---	1.0-2.0	Apparent	Jan-Apr	>60	---	Moderate	Low	High.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Na Napoleon	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High	Moderate	High.
Nf Newton	A/D	None	---	---	+.5-1.0	Apparent	Dec-May	>60	---	Moderate	High	High.
OrB Ormas	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
OvA*: Ormas Variant	B	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	Moderate	High.
Morocco	B	None	---	---	1.0-2.0	Apparent	Jan-Apr	>60	---	Moderate	Low	High.
PlA, PlB, PlC Plainfield	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
PtA Plainfield	A	None	---	---	4.0-6.0	Apparent	Dec-Jun	>60	---	Low	Low	High.
PvB Plainfield	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Px Prochaska	A/D	Occasional	Long	Nov-Jun	+.5-1.0	Apparent	Oct-Jun	>60	---	Moderate	High	Moderate.
Sh Shoals Variant	C	Rare	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	High	Moderate.
So Suman	B/D	Frequent	Brief to long.	Nov-Jun	0-0.5	Apparent	Nov-Jun	>60	---	High	High	Low.
To Toto	B/D	None	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	High	High	Moderate.
Ud*. Udorthents												
Wk Watseka	B	None	---	---	1.0-3.0	Apparent	Feb-May	>60	---	Moderate	Low	High.
WwB Wawasee	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
*Algansee	Mixed, mesic Aquic Udipsamments
Algansee Variant	Sandy over loamy, mixed mesic Aquic Udifluvents
*Brems	Mixed, mesic Aquic Udipsamments
Coloma	Mixed, mesic Alfic Udipsamments
Craigmile	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Fluvaquentic Haplaquolls
Craigmile Variant	Coarse-loamy, mixed, mesic Aeric Haplaquepts
Crosier	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Edwards	Marly, euic, mesic Limnic Medisaprists
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Houghton	Euic, mesic Typic Medisaprists
Markton	Loamy, mixed, mesic Aquic Arenic Hapludalfs
Maumee	Sandy, mixed, mesic Typic Haplaquolls
Maumee Variant	Sandy, mixed, mesic Typic Haplaquolls
*Metea	Loamy, mixed, mesic Arenic Hapludalfs
Morocco	Mixed, mesic Aquic Udipsamments
Napoleon	Dysic, mesic Typic Medihemists
Newton	Sandy, mixed, mesic Typic Humaquepts
Ormas	Loamy, mixed, mesic Arenic Hapludalfs
Ormas Variant	Loamy, mixed, mesic Aquic Arenic Hapludalfs
Plainfield	Mixed, mesic Typic Udipsamments
Prochaska	Sandy, mixed, mesic Fluvaquentic Haplaquolls
Shoals Variant	Fine-loamy, mixed, mesic Aeric Haplaquepts
Suman	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Fluvaquentic Haplaquolls
Toto	Coprogenous, euic, mesic Limnic Medisaprists
Udorthents	Sandy-skeletal, mixed, mesic Typic Udorthents
Watseka	Sandy, mixed, mesic Aquic Hapludolls
Wawasee	Fine-loamy, mixed, mesic Typic Hapludalfs

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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