# SOIL SURVEY OF

# KEWAUNEE COUNTY, WISCONSIN

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Research Division of the College of Agricultural
and Life Sciences, University of Wisconsin

# HOW TO USE

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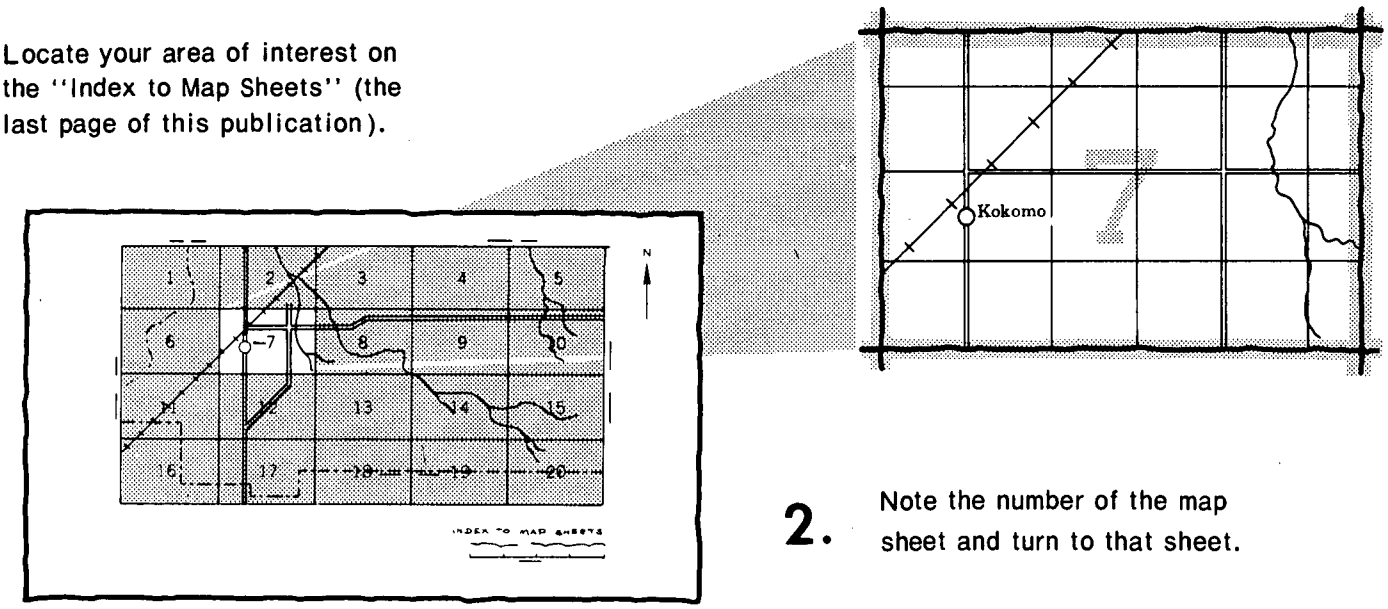


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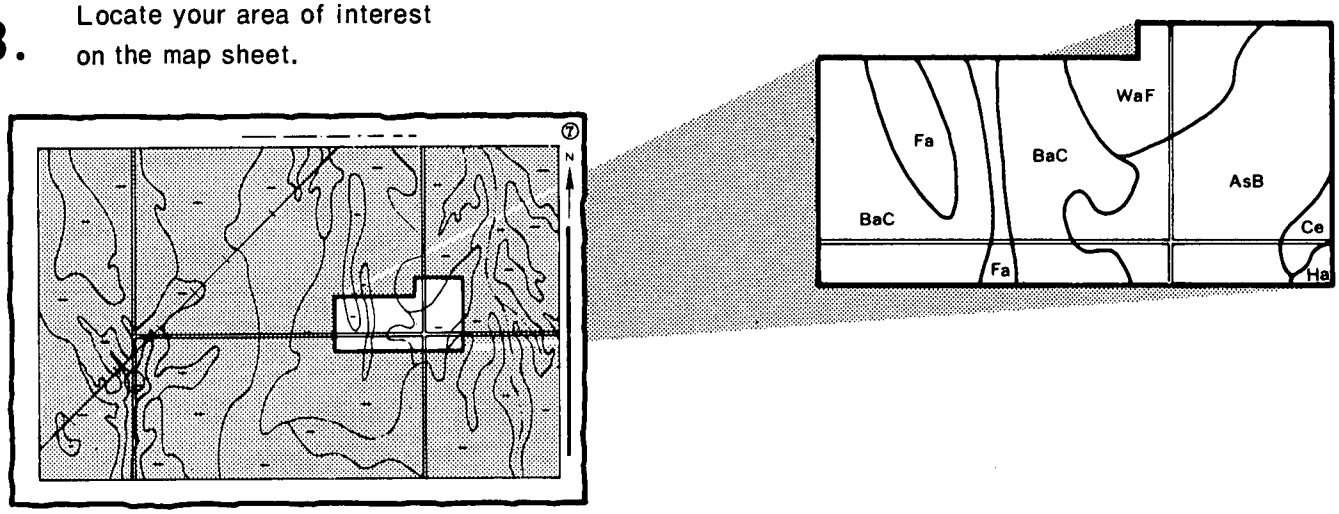


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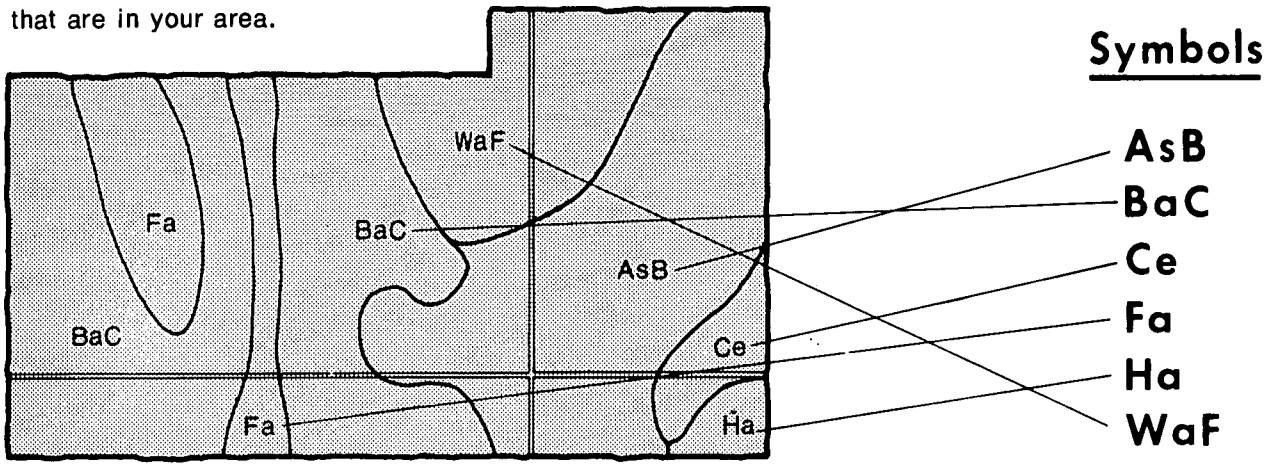

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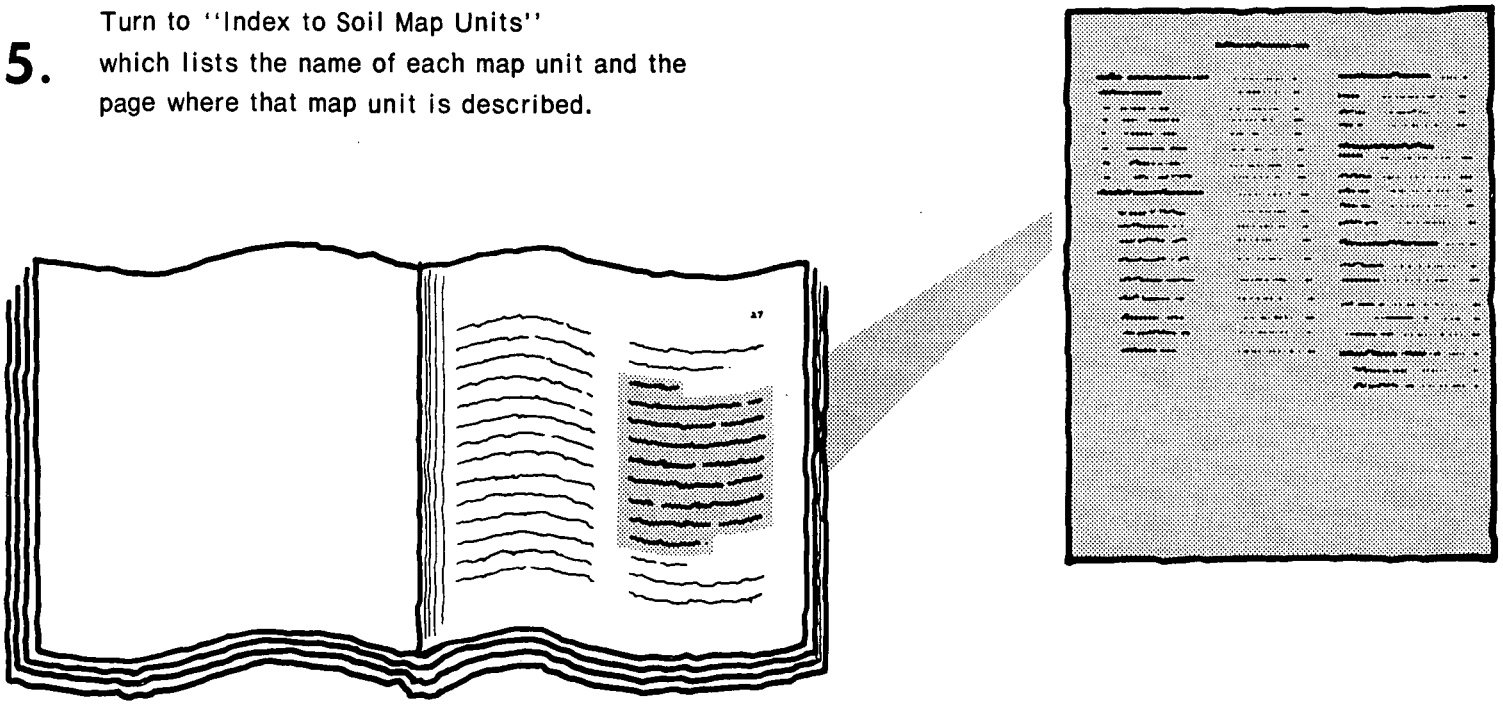

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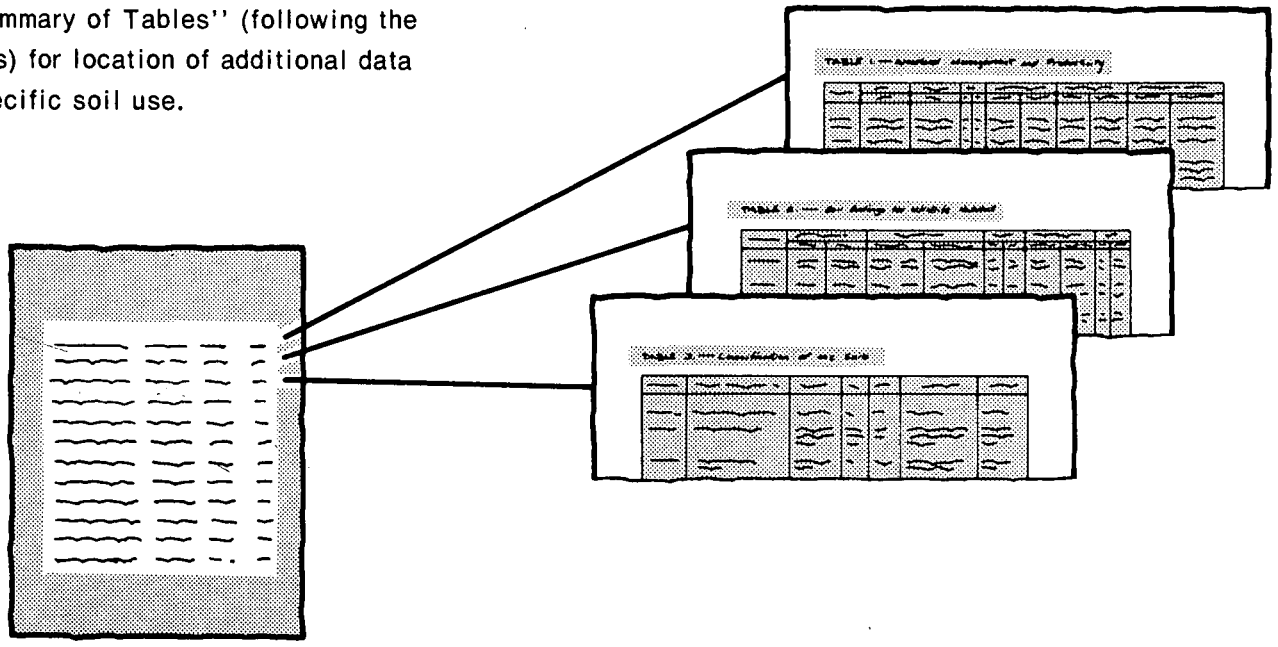

**7.** Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists,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

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

Major fieldwork for this soil survey was performed in the period July 1974 to August 1977. Soil names and descriptions were approved in December 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Kewaunee County Soil and Water Conservation District. Fieldwork was partially funded by the district.

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

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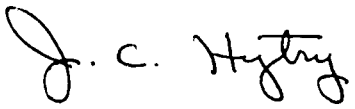
# Foreword

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

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

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

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



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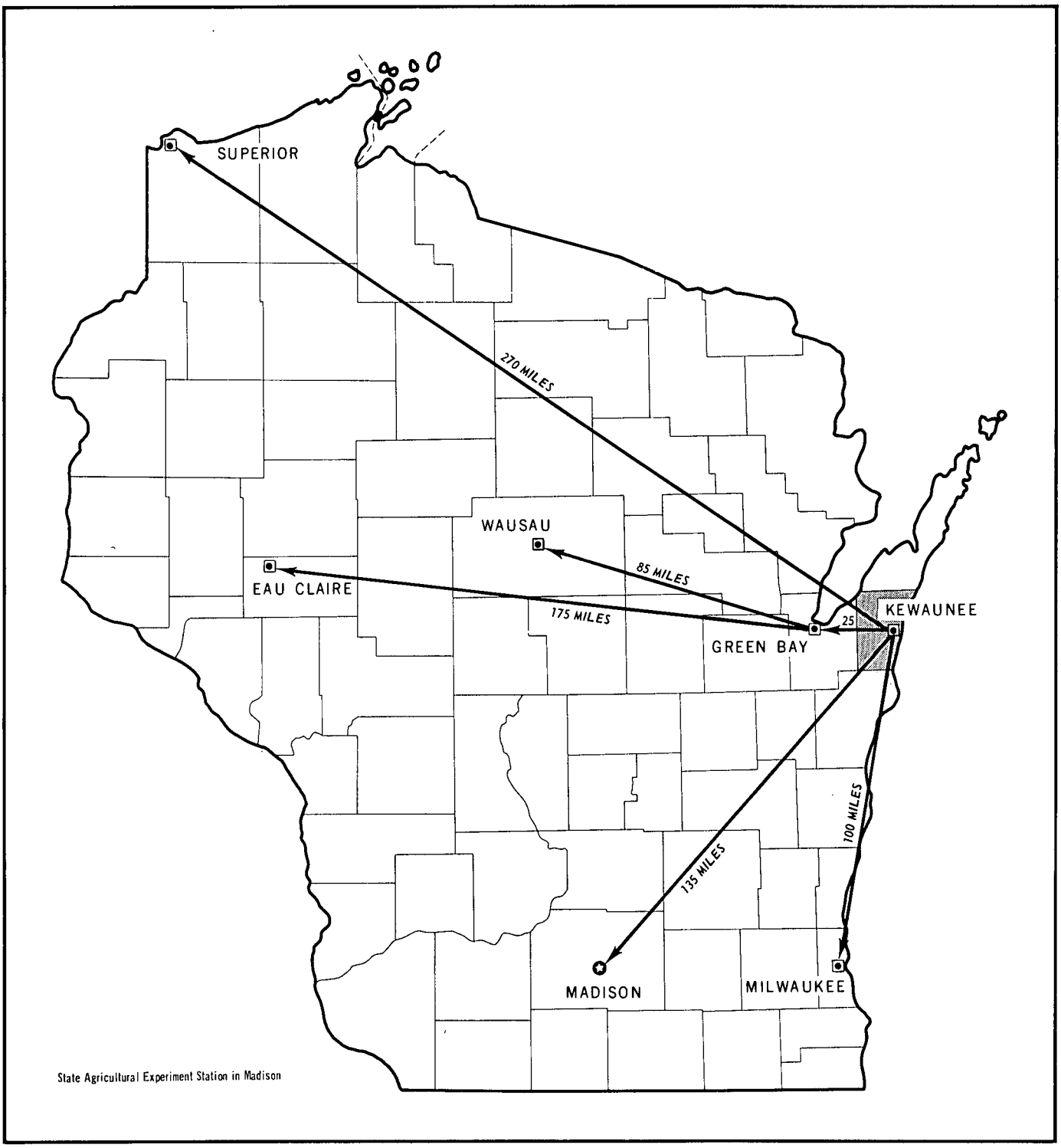


*Location of Kewaunee County in Wisconsin.*

# SOIL SURVEY OF KEWAUNEE COUNTY, WISCONSIN

By Ernest G. Link and Steven W. Frings, Soil Conservation Service

Fieldwork by John E. Campbell, Steven W. Frings, Kim A. Kidney, Ernest G. Link, Augustine J. Otter, and Marvin C. Suhr, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

KEWAUNEE COUNTY is in the eastern part of Wisconsin. It is bordered by Lake Michigan on the east, Door County on the north, Brown County on the west, and Manitowoc County on the south. It has a total area of 211,072 acres.

Algoma is the largest city in the county. It has a population of about 4,000. It is located on the shore of Lake Michigan, approximately 114 miles north of Milwaukee. The county seat is the city of Kewaunee, also on Lake Michigan, about 12 miles south of Algoma. Kewaunee has a population of about 2,900. The villages of Casco and Luxemburg are in the north-central part of the county. There are also 10 civil townships. West Kewaunee is the largest township and Pierce is the smallest.

The population of the county was about 10,000 in 1870, 17,000 in 1900, and 19,000 in l970. Between 1960 and 1970 the county's population increased by 3.7 percent. The state increase for this period was 11.8 percent. The population density in Kewaunee County is 57.3 per square mile; the state average is 80.8 per square mile. Average age is 26.9, slightly lower than the state average of 27.2.

Kewaunee County is moderately urbanized. Slightly more than one-third of the population resides in Algoma and Kewaunee.

In 1970, manufacturing provided 38.0 percent of the employment and farming accounted for 19.1 percent. Statewide, manufacturing accounted for 31.0 percent and farming accounted for 6.5 percent.

About 14 percent of the county is forested. The state is 43 percent forest. Common trees are oak, hard maple, and aspen.

Principal minerals produced are sand and gravel (fig. 1). In 1977 there was about 800 acres of sand and gravel pits in Kewaunee County. This figure excluded pits smaller than 3 acres.

Proper management of agricultural lands to control erosion, remove excess water, minimize pollution, and provide a good economic return is necessary if agriculture is to remain a principal enterprise. Increased manufacturing and demands for services have made both urban and rural planning more necessary.

## General nature of the county

This section gives general information about the county. It describes the climate; geology and underlying material; physiography, relief, and drainage; water supply; history and development; transportation and industry; and farming and land use.

### Climate

The climate of Kewaunee County is continental, although it is modified considerably by Green Bay and Lake Michigan. This modification results in fewer days with extremely high or low temperatures than is common for the latitude. Spring and summer are delayed by the cool water, but summer is usually mild and pleasant. The first freeze in fall is delayed by the then relatively warm lake.

The average date of the last freeze in spring is May 4 and the first in fall is October 12. The growing season between the last 32-degree freeze in spring and the first in fall averages 161 days. Different crops are affected at different temperatures, however, and this growing season designation can be misleading.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Kewaunee in the period 1930 to 1959. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring.

In winter the average December, January, and February temperature is 22.3 degrees F, and the average daily minimum temperature is 14.6 degrees. The lowest temperature on record, which occurred at Kewaunee in January 1951, is -27 degrees. In summer the average June, July, and August temperature is 66.3 degrees, and the average daily maximum temperature is 75.9 degrees. The highest recorded temperature, which occurred in July 1936, is 104 degrees. The annual number of days with temperatures of 90 degrees or higher has varied from 16 in 1931 to 0 in 1940. The number of days with 0 degrees or lower has varied from 28 in 1936 to 2 in 1956.

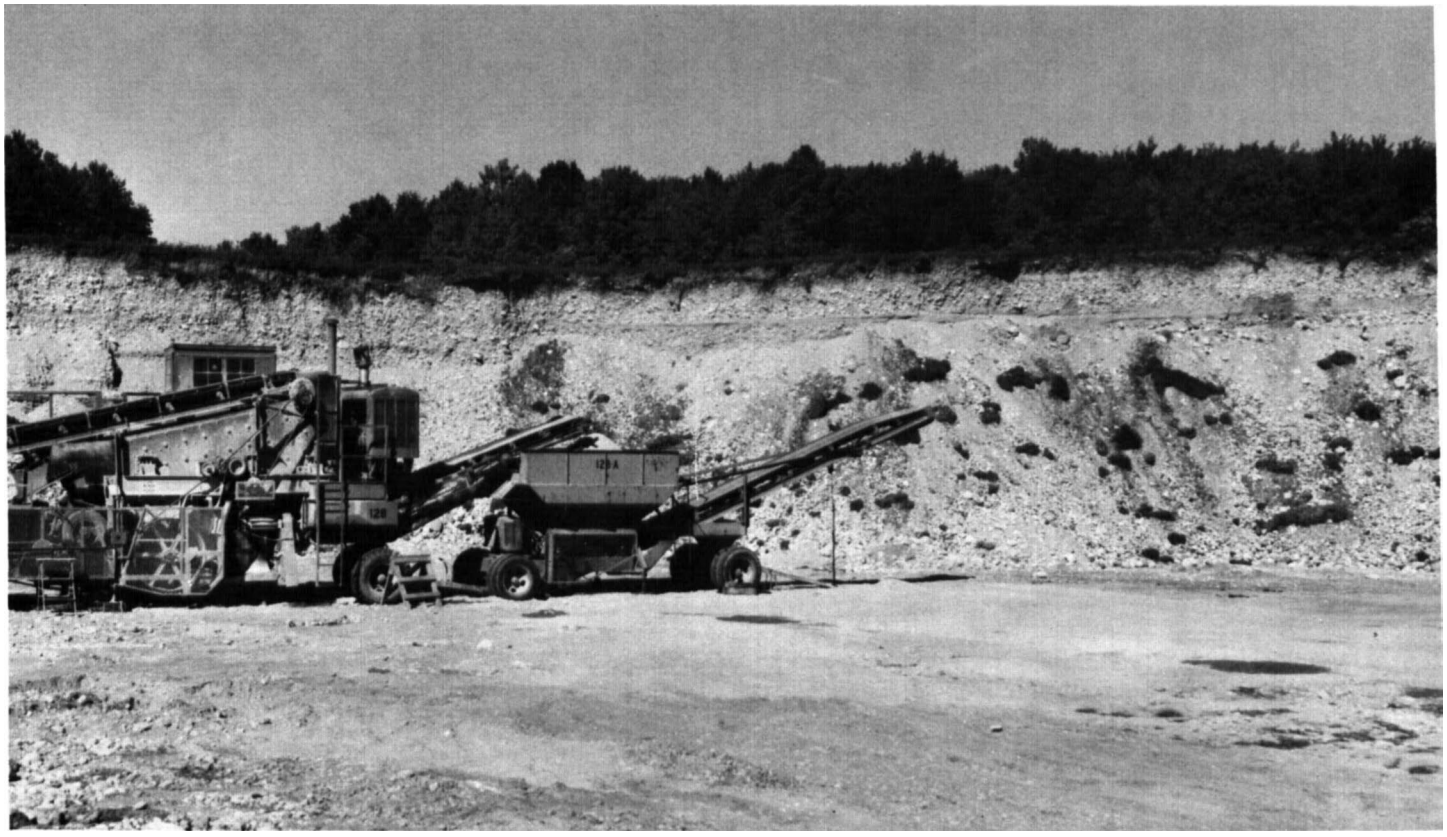

*Figure 1.*—Pit of stratified sand and gravel.

The total annual precipitation is 26.5 inches. Of this, 14.3 inches, or 54 percent, usually falls in May through September, which includes the growing season for most crops. In 3 years out of 30, the rainfall in May through September is less than 11.18 inches. The heaviest 1-day rainfall during the period of record was 4.92 inches at Kewaunee on July 23, 1912. Thunderstorms occur on about 34 days each year.

Average seasonal snowfall is 45.2 inches. The greatest snowfall for any one season during the period of record was 97 inches. The average date of the first snowfall of 1 inch or more is December 2. The chance of this snowfall by November 3 is 1 year in 10 and by December 26 is 9 years in 10. The heaviest 1-day snowfall on record was more than 12 inches.

Humidity records are not available, but data from Green Bay should approximate conditions in Kewaunee County. At Green Bay, relative humidity in winter ranges from an average nighttime maximum of about 80 percent to a daytime minimum of about 70 percent. Relative humidity in summer averages 85 percent at night and 60 percent in the daytime.

## Geology and underlying material

The bedrock formations of Kewaunee County and surrounding areas of northeast Wisconsin are sedimentary deposits of Ordovician and Silurian age. Outcrops are numerous in the northwestern part of the county, but the thickness of these formations is very difficult to ascertain. Depth to the underlying crystalline bedrock is believed to be more than 1,200 feet.

The Niagara Dolomite Formation, of Silurian age, forms the caprock of most of Kewaunee County. This formation, which forms the eastern ridges of Wisconsin, dips uniformly to the south and east at an angle of less than 1 degree (*5*). The western edge of the formation forms an escarpment along the bay of Green Bay. This feature is conspicuous in adjoining counties, but is partly covered by glacial drift in the northwestern corner of Kewaunee County.

Maquoketa Shale of Ordovician age forms the caprock of a narrow strip bordering the bay of Green Bay at Dykesville. This shale is soft and has a distinctive bluish gray color.

Northeastern Wisconsin was glaciated several times. The Cary substage and Valders substage of the Wisconsin glacial period are considered the main source of the drift mantle in Kewaunee County. Glacial ice scoured the bedrock in some places and deposited more than 100 feet of drift in other places. In areas where the bedrock is at or very near the surface there is a serious hazard of pollutants entering the ground water through fissures and crevices in the bedrock.

The interval between the earlier Cary and the later Valders glacial substages was favorable for forests. Exposures of a buried forest bed along the lake bluff in Carlton Township and Two Creeks Township in Manitowoc County have helped geologists identify and determine the age of glacial periods.

Glacial ice of the Cary substage entered northeastern Wisconsin in two lobes. One advanced in a southerly direction in the Fox River Valley; the other advanced in the Lake Michigan Basin. An extremely hilly and choppy area with numerous wet depressions was formed where the two lobes pushed against each other. This area is called the Kettle Moraine. It is associated with some large, nearly level to sloping outwash plains. The Kettle Moraine and the outwash plains form a belt across the county into the counties to the south. Soils that formed in Cary-age drift typically have a substratum of brown or yellowish brown glacial outwash sand and gravel or brown loam glacial till.

Drift was deposited by the more recent Valders substage along the western edge and in eastern portions of the county. The two areas are separated by Cary-age drift. Soils that formed in Valders-age drift typically have a reddish brown loam, clay loam, or clay substratum and are known locally as "red clays." In some places the Valders-age drift is less than 5 feet thick. Soils in these areas typically have a subsoil of reddish brown clay loam or clay and a substratum of brown or yellowish brown loam, sandy loam, or sand and gravel.

Long, narrow, steep-sided gravelly ridges called eskers were formed in Franklin and Montpelier Townships (fig. 2). There are also some small areas of glacial lake sediment, primarily in Franklin.

*Figure 2.*—Rodman-Casco complex, 20 to 35 percent slopes, on an esker, a unique landscape feature in some glaciated areas.

### Physiography, relief, and drainage

The physiography of Kewaunee County is controlled largely by the Niagara Dolomite Formation that underlies most of the county. Slopes are dominantly nearly level to sloping. Approximately 80 percent of the county has slopes of less than 6 percent and about 12 percent has slopes of 6 to 12 percent. Generally, portions of the county occupied by Valders drift have the least relief.

The steeper slopes of the county are valley sides and segments of the Kettle Moraine. These morainic deposits are extremely hilly and choppy areas with numerous depressions, some of which form small lakes. About 8 percent of the county has slopes of more than 12 percent.

Lake Michigan, which borders the county on the east, has a mean lake elevation of 580 feet above sea level. The land elevation rises to about 900 feet in Lincoln and Montpelier Townships.

There are five major watersheds in Kewaunee County. The Red River in Red River Township flows west to the bay of Green Bay. Sand and gravel deposits in the western part of the township, however, suggest that glacial melt water once flowed southeast, forming a tributary to the Kewaunee River. As the glacial ice receded the present drainage pattern was formed.

The Kewaunee and Ahnapee Rivers flow southeast to Lake Michigan. The Kewaunee River Valley is steep-sided and has a floor that in places is 100 feet lower than the adjoining uplands. The physiography of the valley, along with numerous sand and gravel deposits, suggests that the Kewaunee River carried a huge volume of glacial melt water from the bay of Green Bay to Lake Michigan. Although the valley of the Ahnapee River is not as conspicuous as the Kewaunee River Valley, it appears to have also carried glacial melt water to Lake Michigan.

In the central part of West Kewaunee Township the Kewaunee River flows on the Niagara dolomite bedrock. Alluvial deposits occur along the entire length of the river. Organic deposits and marshes occur along both the Kewaunee and the Ahnapee, especially near their outlets into Lake Michigan.

Scarboro Creek drains the west-central part of the county and is a major tributary of the Kewaunee River. Buck and Twin Creeks flow south and drain the southern part of the county.

Several small creeks, most less than 5 miles long, drain the eastern part of the county along Lake Michigan. These creeks typically flow in narrow V-shaped gullies that are severely eroded in some places.

### Water supply

Kewaunee County has abundant supplies of good ground and surface water. Ground water is readily available from the Niagara dolomite aquifer and may also be obtained from gravelly deposits in the glacial drift mantle. Lake Michigan and the bay of Green Bay hold a great supply of surface water.

Sand and gravel aquifer is more important in the south-central section of the county. This surficial outwash material is highly permeable and, therefore, very rapidly rechargeable. In the Niagara dolomite, which underlies most of the county, water moves through cracks, crevices, and fractures to provide an abundant supply to drilled wells.

Hardness is a persistant problem in the quality of ground water. Most of the water in both the Niagara dolomite and gravel aquifers has a total dissolved solids concentration between 200 and 500 mg/liter (*4*). Water with dissolved solids above 180 mg/liter is classified as very hard by the U.S. Geological Survey.

### History and development

French explorers and missionaries first visited the area that is now Kewaunee County in the late 1600's. The area was populated by the Pottawotamee Indians who had an important fishing village near the present site of the city of Kewaunee. It was here that Jacques Vicau, a French trader, erected a short-lived trading post in the year 1795. A lumber mill operation was started in 1837 at the mouth of the Kewaunee River, and the county was established in 1852.

Lumbering was the leading industry, but agricultural development began in the 1850's. Because of the accessible location, settlers followed the lumberjacks to Kewaunee County earlier than in other parts of Wisconsin. Some of the first settlers came from Manitowoc County and neighboring states, but a large proportion came directly from foreign countries. Lincoln and Red River Townships were first settled mainly by Belgians, Luxemburg by Germans, West Kewaunee by Poles, and Carlton by Norwegians.

As the land was cleared, the first farmers grew wheat. Wheat continued to be the the primary crop until the chinch bug reduced yields and profits around 1900, and a gradual switch to dairying began. Farm production has increased steadily, mainly because of drainage of the heavy wet soils and the use of commercial fertilizer. Today, 91 percent of the land is in farms, and dairy products are the largest single source of farm income.

By 1891 rail and boat lines had made the city of Kewaunee an important transportation center. Lumbering and farming accounted for most of the economic activity, but manufacturing began when German woodworking craftsmen settled in the area in the late 1800's. Manufactured products now include wood products, metal household furniture, and machinery.

### Transportation and industry

The Green Bay and Western Railroad crosses Wisconsin from Winona, Minnesota, and terminates at the city

of Kewaunee. This line connects Green Bay and other cities to main line routes to Milwaukee, Chicago, Minneapolis, and St. Paul. Freight rates from Kewaunee County to the eastern U.S. market are generally the same as from Chicago.

A branch rail line once connected with the Green Bay and Western at Casco Junction and ran through Algoma to Sturgeon Bay in Door County. This line was abandoned in 1966, but portions of it have been converted to a bicycle trail or are used for private rail excursions.

The county has good highway connections. Paved, two-lane state highways connect with cities north, west, and south. There is a year-round car ferry across Lake Michigan from Kewaunee. A well maintained network of paved county highways provides access to all parts of the county.

In general, the economic base of Kewaunee County is dominated by agriculture and manufacturing. The cities of Algoma and Kewaunee are the centers of manufacturing.

Algoma is dominated by wood industries. Kewaunee primarily produces metal products, durable goods such as pots and pans, farm equipment, and machine tools. Both cities rely heavily on rail and ferry service for the shipment of raw and finished products.

In recent years, Algoma and Kewaunee have developed growing sport fishing enterprises.

### Farming and land use

Paul Wolske, county agricultural agent, University of Wisconsin, Cooperative Extension Service, helped prepare this section.

In 1974 approximately 71 percent of the county was cropland, 14 percent woodland, and 6 percent other farmland. The remaining 9 percent was nonfarmland.

From 1860 to 1900 wheat was an important grain crop. More than 27,400 acres was harvested in 1880. Since then there has been a gradual increase in the acreage of corn, oats, and hay.

Changes have also taken place in the number and size of farms and the amount of cropland. In 1900 there was a total of 2,100 farms and the average size was 92 acres. By 1975 the total farms had dropped to 1,214 and the average size had increased to 152 acres. Total cropland has declined from a high of 210,000 acres in 1950 to 184,313 acres in 1975. This decline is partially the result of conversion of farmland to nonfarm uses, such as rural nonfarm homes, city expansion, and recreational development.

Just as land use has changed, so have the types and kinds of livestock. The agriculture in the county now is centered primarily around the dairy industry. Thirty-five years ago, farmers produced a large number of hogs, but land use and cropping changes resulted in a strengthening or specialization of the dairy enterprise and a decline in other livestock enterprises. In 1900 there were 31,250 cattle, 7,900 hogs, 13,575 sheep, and 6,488 horses. By 1977 there were 80,100 cattle, 8,000 hogs, 150 sheep, and only a few horses. The production of milk has increased from 5,800 pounds per cow in 1925 to 10,100 pounds per cow in 1974.

The increase in mechanization resulted in the decrease in horses and, more importantly, a more intensive use of cropland. As land became more intensively used, soil losses increased, making the need for soil and water conservation more critical.

Population changes have also produced land use changes. The population has increased, and so has urban development and the demand for more housing, roads, parks, and industrial development. Cropland has been converted to other uses, and land values have generally increased.

Farm ownership is very high in the county. About 95 percent of the farms in the county are owned by the farmers who work them.

## How this survey was made

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

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

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

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

are assembled from farm records and from field or plot experiments on the same kinds of soil.

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

## General soil map for broad land use planning

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

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

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

## Descriptions of map units

### 1. Kewaunee-Manawa

*Nearly level to very steep, well drained and somewhat poorly drained soils that have a moderately fine or fine textured subsoil underlain by fine textured glacial till*

This map unit consists mostly of an undulating till plain with small knolls, hills, and broad ridges dissected by streams and small drainageways. Slopes range from 0 to 35 percent.

This map unit covers about 18 percent of the county. It is about 60 percent Kewaunee soils and about 17 percent Manawa soils. Minor soils make up the remaining 23 percent of the map unit (fig. 3).

Kewaunee soils are gently sloping to very steep and are well drained. They are on small knolls, hills, and broad ridges dissected by streams. Typically, the surface

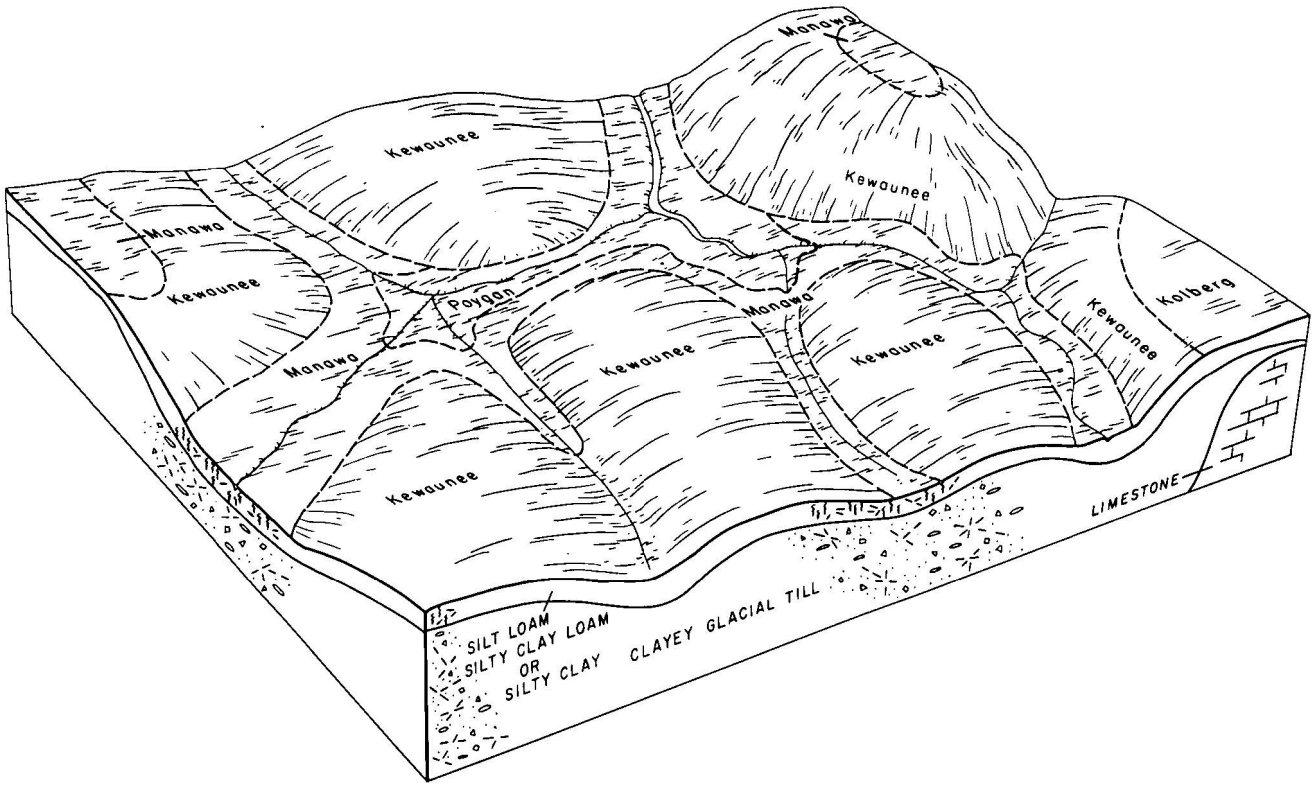


*Figure 3.*—Relationship of soils, underlying material, and landforms in the Kewaunee-Manawa unit on the General Soil Map.

layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 21 inches thick. It is reddish brown, firm silty clay loam in the upper part and reddish brown, firm silty clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay. In some places the surface layer is silty clay loam or silty clay.

Manawa soils are nearly level and gently sloping and are somewhat poorly drained. They are in depressions and drainageways. Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsoil is about 23 inches thick. It is reddish brown, mottled, firm silty clay loam in the upper part and reddish brown, mottled firm clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, mottled, firm clay.

Some of the minor soils in this unit are Casco, Kolberg, and Poygan soils. The well drained Casco soils are underlain by sand and gravel outwash and are along streams. The well drained Kolberg soils are intermingled with Kewaunee soils. Kolberg soils have dolomite bedrock at a depth of 20 to 40 inches. The poorly drained Poygan soils are in drainageways and large depressions.

The major soils in this unit are used mainly to grow cultivated crops, such as corn, small grains, and legumes. Steeper soils and undrained areas of Manawa soils are used for pasture, woodland, or wildlife habitat. Erosion is the main hazard for cultivated crops on Kewaunee soils; wetness is the main limitation on Manawa soils. Erosion is a hazard if the minor Casco and Kolberg soils are cultivated. Poygan soils need drainage for dependable crop production.

The less sloping major soils have good potential for crops. The more sloping soils have fair or poor potential for crops.

The major soils in this unit have fair to poor potential for building site developments and onsite waste disposal. The moderately slow and slow permeability, high shrink-swell potential, low strength, and wetness impose severe limitations that are difficult and expensive to overcome.

The potential is good for woodland on the major soils in this unit. This unit also has good potential for openland and woodland wildlife habitat. Manawa soils have good potential for wetland wildlife habitat.

### 2. Hortonville-Symco

*Nearly level to very steep, well drained and somewhat poorly drained soils that have a moderately fine textured subsoil underlain by medium textured glacial till*

This map unit consists mostly of a broad, undulating till plain with a few sloping to very steep hills and ridges. Slopes range from 0 to 35 percent.

This map unit covers about 34.8 percent of the county. It is about 51 percent Hortonville soils and 16 percent Symco soils. Minor soils make up the remaining 33 percent of the map unit.

Hortonville soils are nearly level to very steep and are well drained. They are on hills and broad ridges. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 28 inches thick. It is mostly reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam.

Symco soils are nearly level and gently sloping and are somewhat poorly drained. They are in depressions and drainageways. Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is about 19 inches thick. It is brown, mottled, firm clay loam in the upper part and reddish brown, mottled, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, mottled, friable loam.

Some of the minor soils in this unit are Carbondale, Pella, and Kolberg soils. The very poorly drained Carbondale soils are in depressions where they formed in deep organic deposits. The poorly drained Pella soils are in drainageways and depressions. Kolberg soils are well drained and are underlain by dolomite bedrock at depths of 20 to 40 inches.

The major soils in this unit are used mainly to grow cultivated crops such as corn, small grains, and legumes. Steeper soils and undrained areas of Symco soils are used mostly for pasture, woodland, or wildlife habitat. Erosion is the main hazard for cultivated crops on Hortonville soils; wetness is the main limitation on Symco soils. The minor Carbondale and Pella soils need drainage for crop production. There is a hazard of erosion on Kolberg soils.

The less sloping major soils have good potential for crops. The more sloping soils have fair to poor potential for crops.

The Hortonville soils in this unit have fair to poor potential for building site developments and onsite waste disposal. Permeability of the Hortonville soils is on the low end of the moderate range and may limit the suitability for septic tank absorption fields. Symco soils have poor potential for building site developments and onsite waste disposal.

The major soils in this unit have good potential for woodland. They have good or fair potential for openland and woodland wildlife habitat. Symco soils have fair potential for wetland wildlife habitat.

### 3. Onaway-Solona-Hortonville

*Nearly level to very steep, well drained and somewhat poorly drained soils that have a medium and moderately fine textured subsoil underlain by medium and moderately coarse textured glacial till*

This map unit consists mostly of a broad, undulating till plain with a few very steep hills and ridges. Slopes range from 0 to 35 percent.

This map unit covers about 10 percent of the county. It is about 23 percent Onaway soils, 13 percent Solona soils, and 7 percent Hortonville soils. Minor soils make up the remaining 57 percent of the map unit (fig. 4).

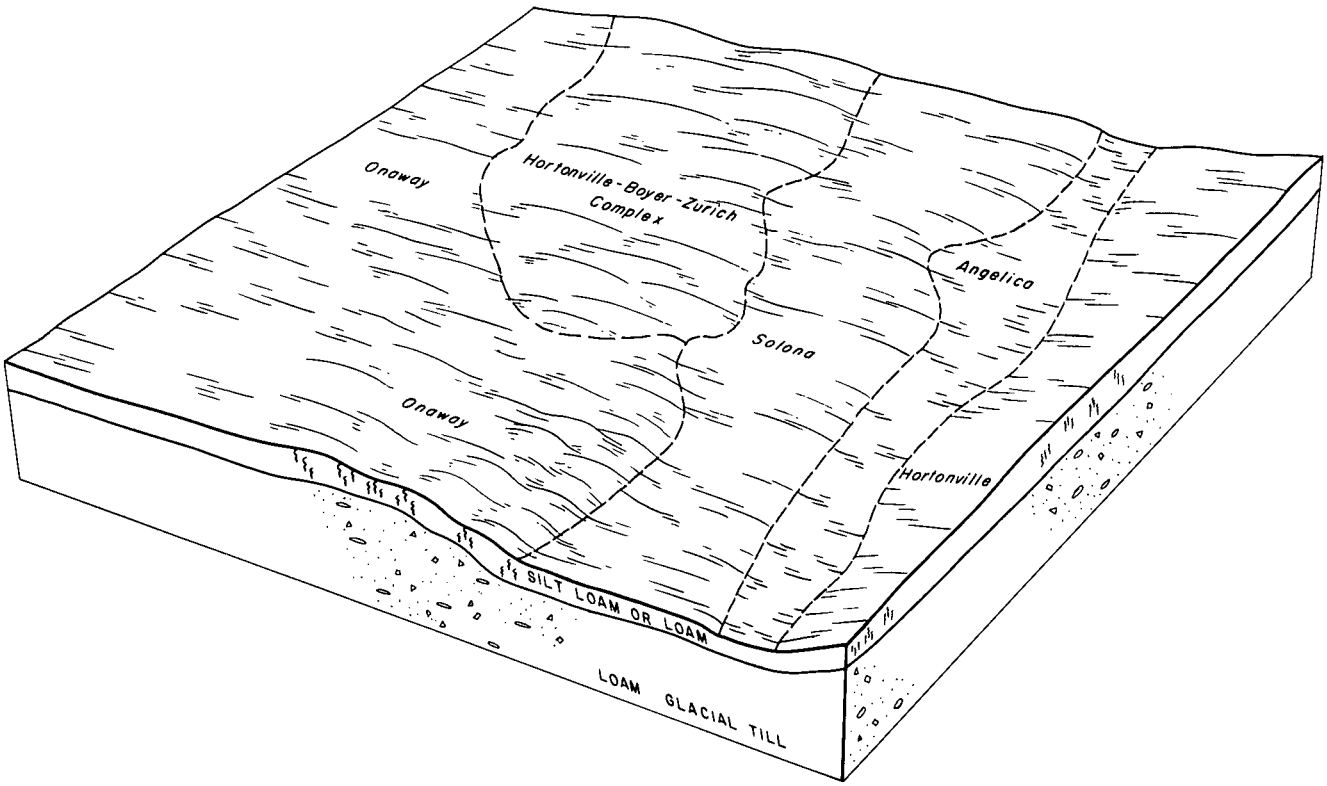


*Figure 4.*—Relationship of soils, underlying material, and landforms in the Onaway-Solona-Hortonville unit on the General Soil Map.

Onaway soils are nearly level to sloping and are well drained. They are on knolls and broad ridges. Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark brown, friable loam in the upper part; pinkish gray, friable sandy loam in the middle; and reddish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is light reddish brown, friable sandy loam.

Solona soils are nearly level and gently sloping and are somewhat poorly drained. They are in depressions and drainageways. Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is about 19 inches thick. It is reddish brown, mottled, friable loam. The substratum, to a depth of about 60 inches, is reddish brown, mottled, friable loam.

Hortonville soils are nearly level to very steep and are well drained. They are on hills and broad ridges. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 28 inches thick. It is mostly reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam.

Some of the minor soils in this unit are Angelica, Boyer, Carbondale, Pella, Symco, and Zurich soils. The poorly drained Angelica and Pella soils are in drainageways and depressions. Most of the well drained Boyer and Zurich soils occur in a complex with Hortonville soils on morainic ridges and hills. Boyer soils are underlain by sand and gravel; Zurich soils are underlain by silty and sandy lake sediment. The very poorly drained Carbondale soils occupy depressions and drainageways. They formed in organic deposits. The somewhat poorly drained Symco soils occupy drainageways and depressions.

The major soils in this unit are used mainly to grow cultivated crops such as corn, small grains, and legumes. Steeper soils and undrained areas of Solona soils are used for pasture, woodland, and wildlife habitat. Erosion is the main hazard for cultivated crops on Onaway and Hortonville soils. Wetness is the main limitation on Solona soils. There is a hazard of erosion on the minor Boyer and Zurich soils if they are cultivated. Angelica, Carbondale, Pella, and Symco soils need drainage for dependable crop production.

Where adequate erosion control and drainage measures are established, the less sloping major soils have good potential for farming. The steeper soils have fair or poor potential for farming.

The well drained soils in this unit have good to poor potential for building site developments and onsite waste disposal. The wet soils have fair potential for these uses. Permeability of the Hortonville soils is on the low end of

the moderate range and may limit the suitability for septic tank absorption fields.

The major soils in this unit have good potential for woodland. They have good or fair potential for openland and woodland wildlife habitat. Solona soils have fair potential for wetland wildlife habitat.

### 4. Waymor-Lamartine-Pella

*Nearly level to very steep and well drained, somewhat poorly drained, or poorly drained soils that have a medium and moderately fine textured subsoil underlain by medium textured glacial till*

This map unit consists of a broad, undulating till plain with a few very steep hills and ridges. Slopes range from 0 to 35 percent.

This map unit covers about 11 percent of the county. It is about 58 percent Waymor soils, 10 percent Lamartine soils, and 9 percent Pella soils. Minor soils make up the remaining 23 percent of the map unit (fig. 5).

Waymor soils are nearly level to very steep and are well drained. They are on knolls, hills, and broad ridges. Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is about 8 inches thick. It is dark brown and brown silt loam. The subsoil is about 23 inches thick. It is mostly dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Lamartine soils are nearly level and gently sloping and are somewhat poorly drained. They are in depressions and drainageways. Typically, the surface layer is about 13 inches thick. It is very dark gray silt loam in the upper part and brown, mottled silt loam in the lower part. The subsoil is about 20 inches thick. The upper part is dark brown, mottled, very friable silt loam and the lower part is dark brown and brown, mottled, friable loam. The substratum, to a depth of about 60 inches, is light brown, mottled, massive, loam.

Pella soils are nearly level, poorly drained soils in depressions and drainageways. Typically, the surface layer is black silt loam about 14 inches thick. The subsoil is about 16 inches thick. It is dark gray, friable silt loam in the upper part and gray, friable loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, mottled firm loam.

Some of the minor soils in this unit are Boyer, Carbondale, Casco, Cathro, and Zurich soils. The well drained

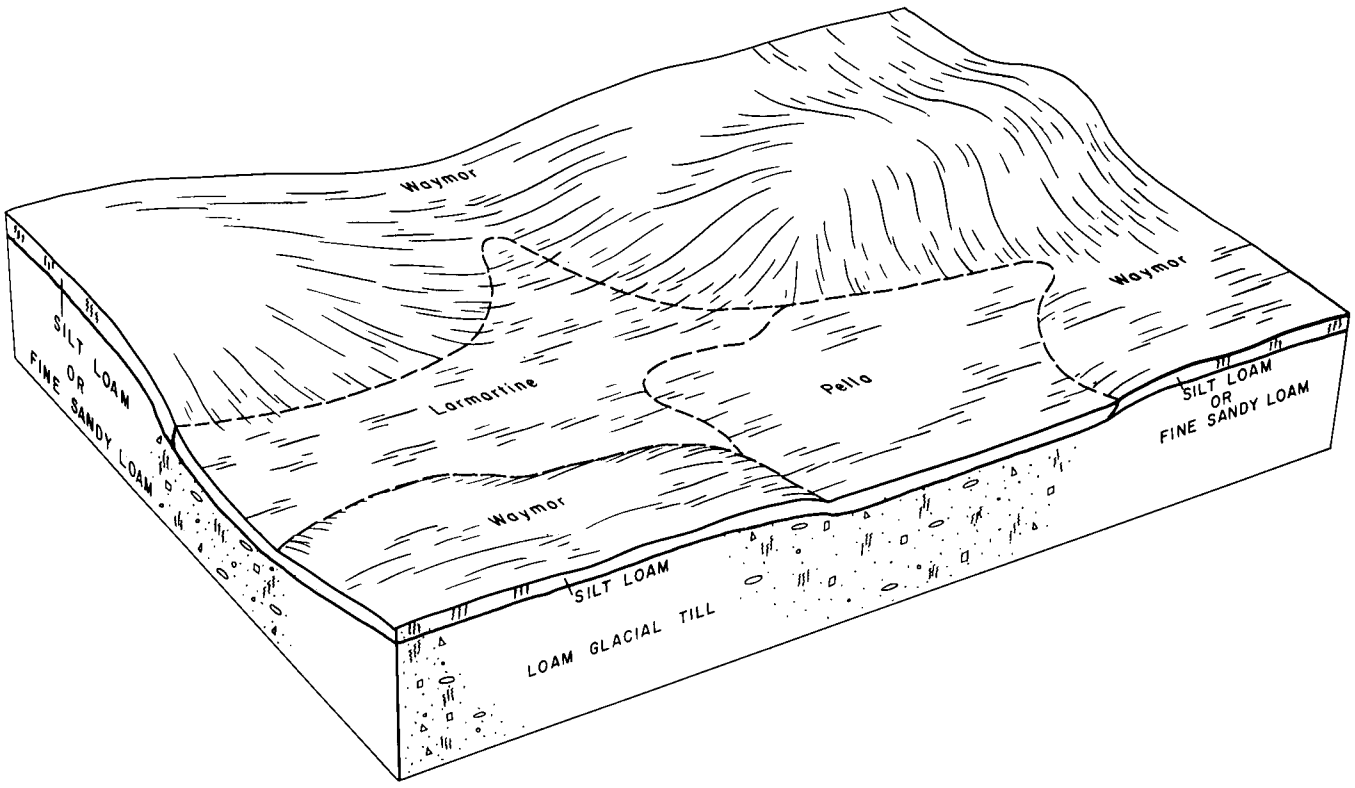


*Figure 5.*—Relationship of soils, underlying material, and landforms in the Waymor-Lamartine-Pella unit on the General Soil Map.

Boyer and Casco soils are intermingled with Waymor soils. They are underlain by sand and gravel. The well drained Zurich soils are underlain by silty and sandy lake sediment. Carbondale and Cathro soils formed in organic deposits in depressions.

The major soils in this unit are used mainly to grow cultivated crops such as corn, small grains, and legumes. The steeper soils and undrained Lamartine and Pella soils are used for pasture, woodland, and wildlife habitat. Erosion is the main hazard for growing cultivated crops on Waymor soils; wetness is the main limitation on Lamartine and Pella soils. There is a hazard of erosion if the minor Boyer, Casco, and Zurich soils are cultivated. Carbondale and Cathro soils need drainage for dependable crop production.

If adequate erosion control and drainage measures are established, the less sloping major soils have good potential for farming. The potential for farming is fair or poor on the steeper soils.

The well drained Waymor soils that are less sloping have good or fair potential for building site developments and onsite waste disposal. The wet soils in this unit have fair to poor potential or are unsuited for such uses.

The major soils in this unit have good potential for woodland and good or fair potential for openland and woodland wildlife habitat. Lamartine and Pella soils have fair or good potential for wetland wildlife habitat.

### 5. Kolberg-Namur-Longrie

*Nearly level to moderately steep, well drained soils that have a fine to medium textured subsoil underlain by dolomite bedrock*

This map unit consists of broad, undulating till plains or outwash plains with a few sloping and moderately steep hills and ridges. Slopes range from 1 to 20 percent.

This map unit covers about 6 percent of the county. It is about 19 percent Kolberg soils, 15 percent Namur soils, and 8 percent Longrie soils. Minor soils make up the remaining 58 percent of the map unit (fig. 6).

Kolberg soils are nearly level to sloping and are well drained. They are on knolls and broad ridges. Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is pinkish gray silt loam about 3 inches thick. The subsoil is about 25 inches thick. It is mostly reddish brown, firm silty clay in the upper part and reddish brown, firm clay in the lower part. Dolomite bedrock is at a depth of about 31 inches.

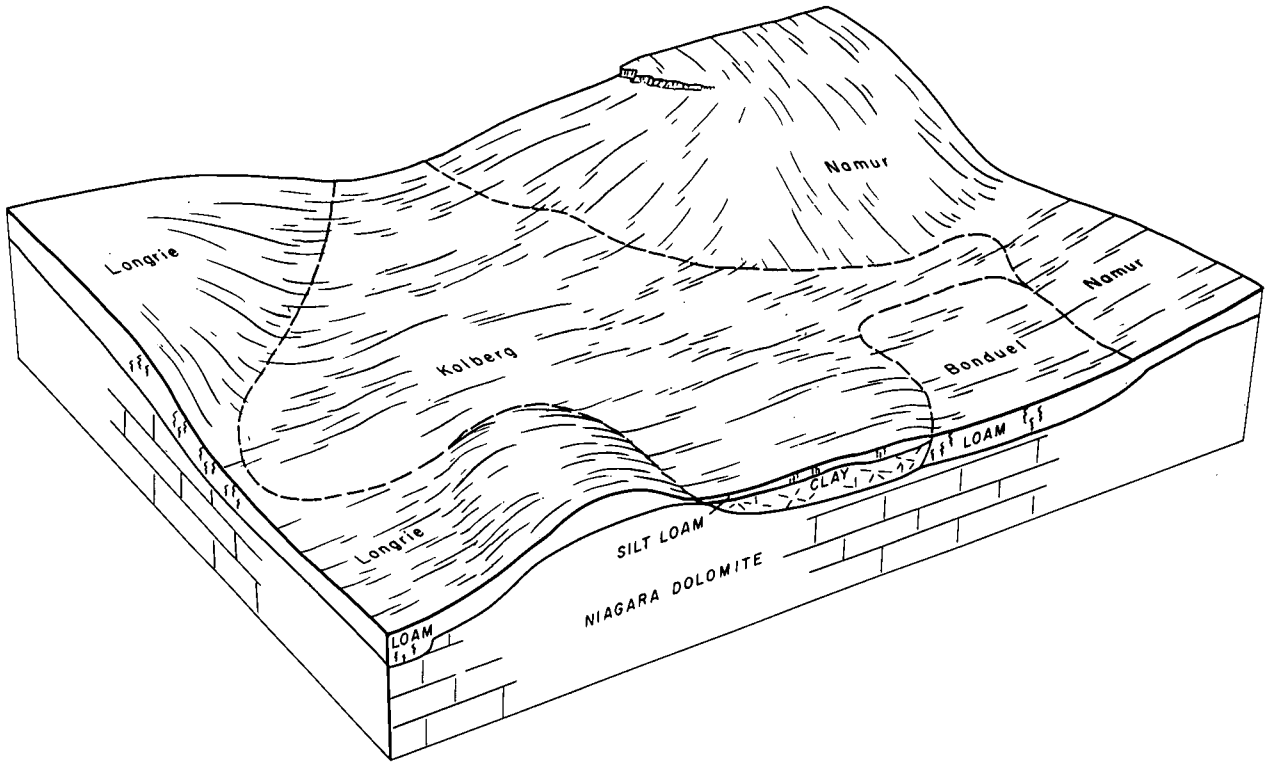


*Figure 6.*—Relationship of soils, underlying material, and landforms in the Kolberg-Namur-Longrie unit on the General Soil Map.

Namur soils are nearly level to moderately steep and are well drained. They are on knolls, hills, and ridges. Typically, the surface layer is very dark brown loam about 5 inches thick. The subsoil is brown loam about 2 inches thick. Dolomite bedrock is at a depth of about 7 inches.

Longrie soils are gently sloping, well drained soils on knolls and ridges. Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 17 inches thick. It is dark brown and brown, very friable and friable loam in the upper part; reddish brown, firm sandy clay loam in the middle; and reddish brown, friable loam in the lower part. The substratum, to a depth of about 28 inches, is brown, friable loam. Dolomite bedrock is at a depth of about 28 inches.

Some of the minor soils in this unit are Bonduel, Hortonville, Kolberg Variant, and Onaway soils. The somewhat poorly drained Bonduel soils occupy drainageways and depressions and have dolomite bedrock at a depth of 20 to 40 inches. The well drained Hortonville and Onaway soils are intermingled with the major soils in this unit. They are underlain by till and are not underlain by dolomite bedrock within a depth of 60 inches. The Kolberg Variant soils are well drained and have dolomite bedrock at a depth of 12 to 20 inches. They are commonly associated with Kolberg soils. Also included are outcrops of dolomite bedrock commonly near areas of Namur soils.

Kolberg and Longrie soils are used mainly to grow cultivated crops such as corn, small grains, and legumes. The very shallow Namur soils are used for pasture, woodland, and wildlife habitat. Erosion and droughtiness are the main hazard for farming.

Where adequate erosion control and moisture retention measures, such as surface mulch, are used, the Kolberg and Longrie soils have good potential for farming. Namur soils have poor potential for farming.

The major soils in this unit have fair to poor potential for building site developments and onsite waste disposal because dolomite is close to the surface.

The potential for woodland and for openland and woodland wildlife habitat is good on Kolberg and Longrie soils and poor on Namur soils. The major soils in this unit have very poor potential for wetland wildlife habitat.

### 6. Casco-Boyer

*Nearly level to very steep, well drained soils that have a medium to coarse textured subsoil underlain by coarse textured sediment*

This map unit consists of broad outwash plains and stream terraces with some very steep morainic hills and ridges. Slopes range from 0 to 35 percent.

This map unit covers about 13 percent of the county. It is about 27 percent Casco soils and 8 percent Boyer soils. Minor soils make up the remaining 65 percent of the unit.

Casco soils are nearly level to very steep and are well drained. They are on outwash plains and terraces and very steep morainic hills and ridges. Typically, the surface layer is dark brown sandy loam about 7 inches thick. The subsoil is dark reddish brown, friable loam about 11 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel.

Boyer soils are nearly level to very steep and are well drained. They are on knolls, hills, and ridges. Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 4 inches thick. The subsoil is about 22 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Some of the minor soils in this unit are Carbondale, Dresden, Fabius, Markey, Matherton, Menominee Variant, Mussey, Oakville, and Waymor soils. The well drained Dresden, Menominee Variant, and Oakville soils are intermingled with Casco and Boyer soils. Dresden soils have 20 to 40 inches of loamy material over sand and gravel. Menominee Variant soils have 20 to 40 inches of sand over gravelly sand. Oakville soils are sandy throughout. Carbondale and Markey soils occupy large depressions and some flood plains along major streams. They formed in organic deposits. The somewhat poorly drained Fabius and Matherton soils occupy drainageways and depressions in outwash plains. The well drained Waymor soils occupy low hills on till plains.

The major soils in this unit are used mainly to grow cultivated crops such as corn, small grains, and legumes. Steeper soils are used for pasture, woodland, and wildlife habitat. Erosion and droughtiness are the main hazards for farming.

Where adequate erosion control and moisture retention measures, such as surface mulches, are used, the less sloping major soils have good or fair potential for farming. The steeper soils have fair or poor potential for farming.

The less sloping major soils have good potential for building site developments and onsite waste disposal. Because of the very rapid permeability in the substratum, however, there is a danger of ground water contamination from septic tanks. Steeper soils have fair or poor potential for these uses.

The potential is good for woodland on the major soils. The potential is fair for openland and woodland wildlife habitat and very poor for wetland habitat.

### 7. Carbondale-Cathro-Markey

*Nearly level, very poorly drained organic soils underlain by organic layers or by loamy and sandy sediment*

This map unit consists of broad lake plains and small depressions in till plains, outwash plains, and drainageways. Slopes range from 0 to 2 percent.

This map unit covers about 7 percent of the county. It is about 50 percent Carbondale soils, 17 percent Cathro

soils, and 15 percent Markey soils. Minor soils make up the remaining 18 percent of the unit.

In a typical Carbondale soil, the organic layers are black muck about 27 inches thick, underlain to a depth of about 60 inches by black mucky peat.

In a typical Cathro soil, the organic layers are black muck about 25 inches thick. The substratum, to a depth of about 60 inches, is gray silty clay loam in the upper part and dark reddish gray loam and silt loam in the lower part.

In a typical Markey soil, the organic layers are black muck about 20 inches thick over dark reddish brown muck 6 inches thick. The substratum, to a depth of about 60 inches, is gray, loose, fine sand.

Some of the minor soils in this unit are the poorly drained and very poorly drained Bach and Roscommon soils. Bach soils formed in loamy material underlain by stratified silt and very fine sand. Roscommon soils are sandy throughout.

The major soils in this unit are used mainly for woodland, wildlife habitat, and aesthetic purposes. Wetness is the main limitation for most uses.

Unless drained, the major soils have poor potential for farming. Because the water table is at or near the surface, these soils have poor potential for building site developments and onsite waste disposal.

The major soils in this unit have fair potential for woodland, but wetness limits the number of adapted species and their growth rate. The potential is poor for openland and woodland wildlife habitat and fair or good for wetland wildlife habitat.

### 8. Wainola-Oakville

*Nearly level to sloping, somewhat poorly drained and well drained soils that have a coarse textured subsoil underlain by coarse textured sediment*

This map unit consists of narrow depressions, beach ridges, and sand dunes on lake and outwash plains. Slopes range from 0 to 12 percent.

This map unit covers about 0.2 percent of the county. It is about 20 percent Wainola soils and 12 percent Oakville soils. Minor soils make up the remaining 68 percent of the unit.

Wainola soils are nearly level and gently sloping and are somewhat poorly drained. They are in depressions on lake plains and outwash plains and on lake beaches. Typically, the surface layer is very dark grayish brown loamy fine sand about 6 inches thick. The subsurface layer is about 7 inches thick. It is dark grayish brown, loamy fine sand in the upper 3 inches and light gray fine sand in the lower 4 inches. The subsoil is about 16 inches thick. It is dark yellowish brown, mottled, very friable fine sand in the upper part; yellowish brown, mottled, friable fine sand in the middle; and yellowish brown, mottled, loose fine sand in the lower part. The substratum, to a depth of about 60 inches, is grayish brown, loose fine sand.

Oakville soils are nearly level to sloping and are well drained. They are on sand dunes and beach ridges of lake plains. Typically, the surface layer is dark brown loamy fine sand about 7 inches thick. The subsoil is about 15 inches thick. It is brown and strong brown in the upper part and reddish yellow in the lower part. It is loose, fine sand throughout. The substratum, to a depth of about 60 inches, is reddish yellow, loose fine sand.

Some of the minor soils in this unit are Angelica and Carbondale soils and Udorthents, 25 to 50 percent slopes. The poorly drained Angelica soils occupy drainageways and depressions. Carbondale soils formed in organic deposits and occupy depressions. The Udorthents occupy lake bluffs and side slopes along drainageways.

The major soils in this unit are used mainly for pasture, woodland, or wildlife habitat. Droughtiness and erosion are the main hazards for farming Oakville soils; wetness is the main limitation on Wainola soils. Wetness is also the main limitation on the minor Angelica and Carbondale soils. Erosion is the main hazard on Udorthents, 25 to 50 percent slopes.

If irrigated, Oakville soils have good potential for crops. If adequately drained, Wainola soils have fair potential for crops.

Oakville soils have good potential for building site developments and poor potential for onsite waste disposal. They are suited for septic tank absorption fields, but there is a danger of ground water pollution because of rapid permeability. The wet Wainola soils have fair potential for building site developments and onsite waste disposal.

The potential is fair or good for woodland.

The well drained Oakville soils have fair potential for openland and woodland wildlife habitat and very poor potential for wetland wildlife habitat. Wainola soils have fair potential for woodland wildlife habitat and poor potential for wetland wildlife habitat.

## Soil maps for detailed planning

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

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

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management. Some

of the methods described for overcoming soil hazards and limitations are controlled by local and state ordinances that should be referred to before construction.

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Casco sandy loam, 0 to 2 percent slopes, is one of several phases in the Casco 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. Casco-Rodman complex, 2 to 6 percent slopes, is an example.

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

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

Table 3 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

**AdA—Allendale loamy fine sand, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions on lake plains and till plains. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsoil is about 23 inches thick. It is dark brown and brown, mottled, very friable fine sand in the upper part; reddish brown, mottled, friable sandy loam in the middle; and reddish brown, firm mottled, silty clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, mottled, firm silty clay.

Included with this soil in mapping are small areas of Wainola and Wauseon soils. Wainola soils occupy similar positions on the landscape. They are somewhat poorly drained and sandy throughout. Wauseon soils are very poorly drained and are lower. They formed in loamy material underlain by clay. Included areas make up 5 to 10 percent of the unit.

Water and air move through the upper part of this Allendale soil at a rapid rate and through the lower part at a slow rate. Surface runoff is slow. Available water capacity is low. Natural fertility is low. Organic matter content of the surface layer is moderately low or moderate. Root development is restricted by a seasonal high water table at a depth of 0.5 to 1.5 feet.

Most areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. The potential is fair for engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops where artificial drainage is provided. Surface drainage is effective in removing excess surface water. Tile may be effective if placed in the clayey substratum. If placed in the sandy subsoil the sand could plug the tile unless protected by a suitable filter. Diversions and grassed waterways are used to control runoff from adjacent slopes. In dry years when the seasonal water table is low, crop yields are limited by the low available water capacity. Soil blowing may also be a problem. Windstrips, windbreaks, conservation tillage, and crop rotation can decrease soil blowing.

If drained, this soil is moderately suited to pasture or hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and slow permeability in the substratum. These problems can perhaps be overcome by building a filtering mound of suitable material, and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table, low strength, and high shrink-swell potential. The seasonal water table can perhaps be lowered by placing drains around foundation footings and using gravity or sump outlets. Problems caused by the low strength and high shrink-swell potential can perhaps be overcome by placing a layer of

coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIIw-6 and woodland suitability subclass 3o.

**Ax—Angelica silt loam.** This nearly level, poorly drained soil is on plane and concave slopes in depressions on till plains. It is subject to frequent flooding for long periods. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is black silt loam about 6 inches thick. The subsoil is about 15 inches thick. It is grayish brown, mottled, very friable silt loam in the upper part and reddish brown, mottled, friable loam in the lower part. The substratum, to a depth of about 60 inches, is brown, mottled, friable loam. In some places the substratum is gravelly loam or sandy loam.

Included with this soil in mapping are small areas of Cathro soils that occupy lower areas in the landscape. These Cathro soils have 16 to 50 inches of organic deposits over mineral soil. Also included are some small areas of Solona soils that are somewhat poorly drained and are higher. Also included are some small areas where the substratum is gravel. Included areas make up 5 to 10 percent of the unit.

Water and air move through this Angelica soil at a moderately slow rate. Surface runoff is slow. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low. Roots are restricted by the seasonal high water table within 1 foot of the surface.

Some areas are drained and farmed. Undrained areas are used for wildlife habitat. This soil has good potential for cultivated crops, hay, and pasture and fair potential for trees. It has poor potential for most engineering uses. It has good potential for wetland wildlife habitat (fig. 7).

This soil is suited to corn, small grain, and other cultivated crops if drainage is provided. Surface and tile drainage are effective in removing excess water. Diversions and grassed waterways are used to control runoff from adjacent slopes.

If drained, this soil is suited to pasture and hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods can reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

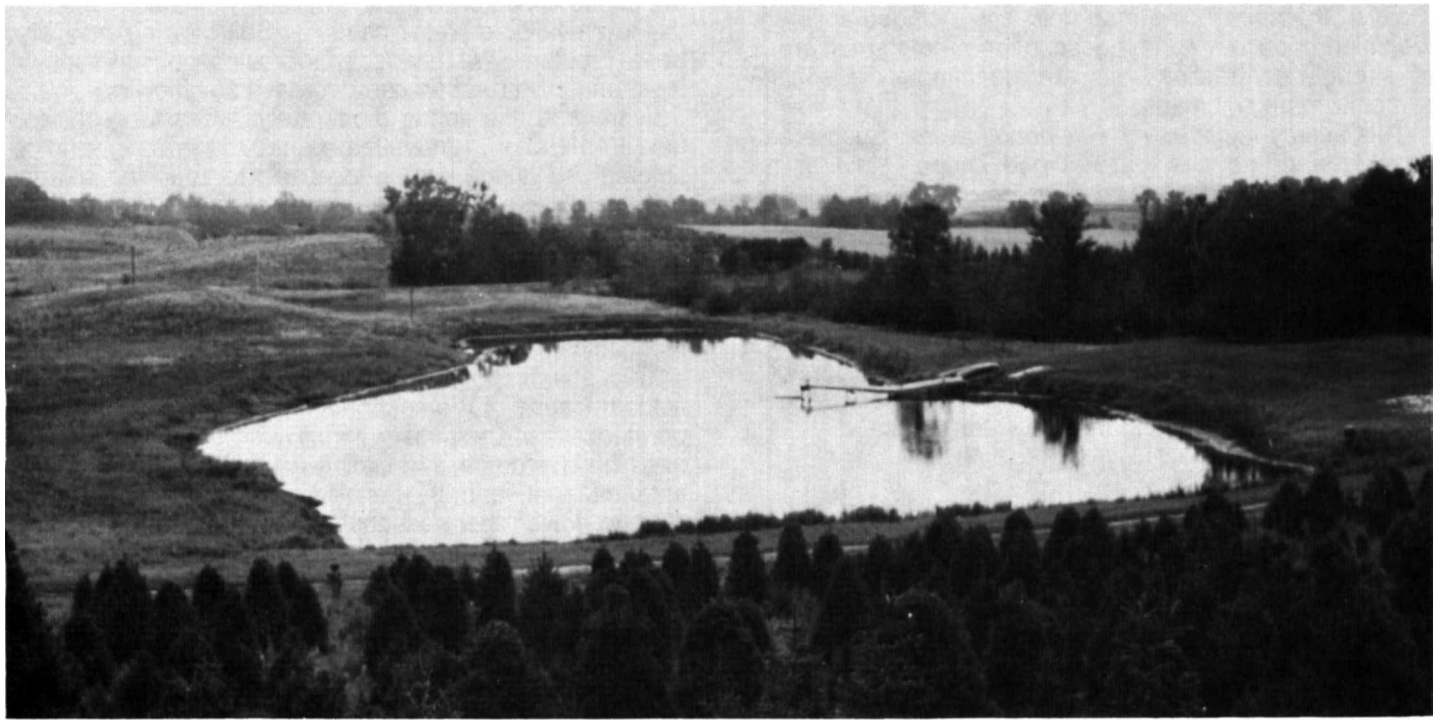

*Figure 7.*—Pond dug in Angelica silt loam.

Because of the high water table and flooding, this soil is poorly suited to septic tank absorption fields and dwellings with or without basements.

This soil is in capability unit IIw-1 drained and VIw-1 undrained. It is in woodland suitability subclass 4w.

**Ba—Bach silt loam.** This nearly level, poorly drained soil is on plane slopes in depressions on lake plains. It is frequently flooded for long periods. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is black and very dark gray silt loam about 10 inches thick. The subsoil, about 4 inches thick, is dark gray, very friable very fine sandy loam. The substratum, to a depth of about 60 inches, is multicolored, stratified silt and very fine sand. In some places the subsoil is silt loam or fine sandy loam. Thin layers of silty clay loam occur in the substratum in some places.

Included with this soil in mapping are small areas of Kibbie and Shiocton soils. These soils are somewhat poorly drained and are higher on the landscape. Kibbie soils also have more clay in the subsoil. Also included are some areas where the subsoil is silty clay loam. Included areas make up 10 to 15 percent of the unit.

Water and air move through this Bach soil at a moderate rate. Surface runoff is very slow, and available water capacity is high. The substratum is moderately alkaline and calcareous. Natural fertility is medium and organic matter content of the surface layer is moderate or moderately low. Roots are restricted by the seasonal high water table within 1 foot of the surface.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. The potential is poor for most engineering uses. It is good for wetland wildlife habitat.

This soil is suited to corn, small grain, and other cultivated crops where artificial drainage is provided. Surface drains and deep ditches can help remove excess water. There is, however, a hazard of silt and very fine sand filling the bottom of drainage ditches. Tile drains are generally not recommended because of the tendency of silt and very fine sand to plug tile lines. This may be prevented by placing a filter over the tile. Diversions and grassed waterways are used to control runoff from adjacent slopes.

If drained, this soil is suited to pasture and hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods can reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

Because of the high water table and flooding, this soil is poorly suited to septic tank absorption fields and dwellings with or without basements.

This soil is in capability unit IIw-6 drained and VIw-1 undrained. It is in woodland suitability subclass 2w.

**Bn—Bonduel loam.** This nearly level, somewhat poorly drained, moderately deep soil is on plane and concave slopes in depressions and drainageways on till plains. It is subject to rare flooding. Individual areas are elongated in shape and range from 3 to 30 acres in size.

Typically, the surface layer is very dark brown loam about 6 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown, friable loam in the upper part; reddish brown, mottled, friable loam in the middle; and reddish brown, mottled, friable fine sandy loam in the lower part. The substratum, about 5 inches thick, is light brown, mottled, friable sandy loam. Dolomite bedrock is at a depth of about 30 inches.

Included with this soil in mapping are small areas of Kolberg, Longrie, Ruse, and Solona soils. Kolberg and Longrie soils are higher and are well drained. Ruse soils are lower, are poorly drained, and have bedrock at a depth of 10 to 20 inches. Solona soils occupy landscape positions similar to those of the Bonduel soil but do not have bedrock within a depth of 60 inches. Also included are small areas where bedrock outcrops at the surface, areas where bedrock is less than 20 inches deep, and areas where bedrock is at a depth of 40 to 60 inches. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Bonduel soil at a moderate rate. Surface runoff is slow. Available water capacity is low. Natural fertility is medium, and organic matter content of the surface layer is moderate. Roots of most crops are restricted by a seasonal high water table at a depth of 1 to 3 feet and by the dolomite bedrock at a depth of 20 to 40 inches.

Most areas are farmed. The potential is good for cultivated crops, hay, and pasture and fair for trees. It is fair for most engineering uses.

If drained, this soil is suited to corn, small grain, and other cultivated crops. The depth to the dolomite bedrock limits the kind of drainage that can be used. Where bedrock is at sufficient depth, surface and tile drains can help remove excess water. Diversions, tiling, and grassed waterways are used to control runoff and seepage from adjacent slopes.

In dry years when the seasonal high water table is low, crop yields are limited by the low available water capacity. Conservation tillage and crop rotation can help maintain the productive capacity of this soil.

This soil is suited to pasture and hay. Drainage, fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest.

This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table, flooding, and the dolomite bedrock at a depth of 20 to 40 inches. These problems can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is moderately suited to dwellings without basements, but the seasonal high water table and rare flooding may cause a wetness problem. This problem can perhaps be overcome by lowering the seasonal high water table with tile drains placed around foundation footings using gravity or sump outlets. This soil is poorly suited to dwellings with basements because of the seasonal high water table, flooding, and the bedrock at a depth of 20 to 40 inches. These problems can perhaps be overcome by lowering the seasonal high water table with tile drains placed around foundation footings using gravity or sump outlets. Building designs should take into account the depth to bedrock.

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

**Bo—Borosaprists.** These nearly level, poorly drained soils are in marshy areas adjacent to major streams, ponds, or lakes on till plains or outwash plains. These soils are flooded most of the year. Individual areas that are adjacent to lakes or streams are elongated in shape and range from 5 to 100 acres in size. Areas in marshy depressions are rounded in shape and range from 3 to 10 acres in size.

Typically, these soils consist of organic deposits that are underlain by mineral soil material or marl.

Included with these soils in mapping are small areas of Carbondale, Cathro, and Fluvaquent soils that are slightly higher on the landscape. These soils are not flooded as frequently as Borosaprists. Carbondale soils have organic deposits to a depth of more than 51 inches. Cathro soils have organic deposits to a depth of 16 to 51 inches and are underlain by loamy soil material. Fluvaquents are poorly drained or very poorly drained and consist of stratified alluvial deposits that have a wide range in texture.

The important soil properties and qualities of these Borosaprists are too variable to rate. Surface runoff is ponded.

These soils remain in wetland vegetation. The potential is poor for crops, trees, and most engineering uses. It is good for wetland wildlife habitat.

These soils are generally unsuited to agricultural or woodland uses and to dwellings and septic tanks. Most areas are not practical to drain because of their low position in the landscape and a lack of suitable outlets. They provide excellent habitat for waterfowl and furbearing animals. They also provide fish spawning areas and filter pollutants from the surface runoff from adjoining uplands.

These soils are in capability unit VIIIw-15. They are not assigned to a woodland suitability subclass.

**BrB—Boyer loamy sand, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on convex slopes of knolls and on outwash plains. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsurface is yellowish brown loamy sand about 4 inches thick. The subsoil is about 22 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Included with this soil in mapping are small areas of Casco, Oakville, and Rodman soils that occupy similar landscape positions. Casco soils have a thinner subsoil that contains more clay. Oakville and Rodman soils have less clay in the subsoil. Rodman soils have more gravel. Also included are small areas of Boyer soils with slopes of more than 6 percent. Included areas make up 5 to 10 percent of the unit.

Water and air move through the subsoil of this Boyer soil at a moderately rapid rate and through the substratum at a very rapid rate. Surface runoff from cultivated areas is slow. Available water capacity is low. Natural fertility is low. Organic matter content of the surface layer is moderate to low.

Most areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. It is good for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. There is a moderate soil blowing hazard. Crop rotation, conservation tillage, windstrips, and windbreaks help to control blowing and maintain the productive capacity of this soil. Returning crop residues and applying manure help to decrease erosion and improve fertility.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields and dwellings with or without basements, but there is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IIIs-4 and woodland suitability subclass 3s.

**BrC—Boyer loamy sand, 6 to 12 percent slopes.** This sloping, well drained soil is on convex slopes of broad ridges on outwash plains. Individual areas are elongated in shape and range from 3 to 40 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 7 inches thick. The subsurface layer is yellowish brown loamy sand about 4 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Included with this soil in mapping are small areas of Casco, Oakville, and Rodman soils that occupy similar landscape positions. Casco soils have a thinner subsoil that contains more clay. Oakville and Rodman soils have less clay in the subsoil. Rodman soils have more gravel. Also included are some small gently sloping and moderately steep Boyer soils and severely eroded Boyer soils. Included areas make up 5 to 10 percent of the unit.

Water and air move through the subsoil of this Boyer soil at a moderately rapid rate and through the substratum at a very rapid rate. Surface runoff from cultivated areas is medium. Available water capacity is low. Natural fertility is low. Organic matter content of the surface layer is moderate to low.

Some areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. It is good for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. There is a moderate erosion and soil blowing hazard. Conservation tillage, crop rotation, contour farming, contour stripcropping, grassed waterways, windstrips, and windbreaks can reduce soil blowing and erosion. Returning crop residues and applying manure help to decrease erosion and improve fertility.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields and to dwellings with or without basements. Slope is a problem, but it can be overcome by land leveling or shaping. There is a problem of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IIIe-12 and woodland suitability subclass 3s.

**BrE—Boyer loamy sand, 20 to 35 percent slopes.** This steep and very steep, well drained soil is on convex slopes on escarpments at the edge of outwash plains, terraces, and eskers. Individual areas are elongated in shape and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 5 inches thick. The subsurface layer is yellowish brown loamy sand about 3 inches thick. The subsoil is about 16 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Included with this soil in mapping are small areas of Oakville and Rodman soils that occupy similar landscape positions. Oakville and Rodman soils have less clay in the subsoil than Boyer soils. Rodman soils have more gravel. Also included are some small areas of moderately steep Boyer soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Boyer soil at a moderately rapid rate and through the substratum at a very rapid rate. Surface runoff from cultivated areas is rapid, and available water capacity is low. Natural fertility is low. The organic matter content of the surface layer is moderate to low.

Most areas are in woodland, and a few areas are farmed. The potential is poor for cultivated crops, hay, and pasture. It is fair for trees and poor for most engineering uses.

This soil is generally unsuited to farming because of very steep slopes. There is a severe erosion hazard, and yields in most years are limited by the low available water capacity.

This soil is suited to woodland. Soil-related forest management problems are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest can minimize erosion. Seedling survival on steeper slopes facing south or west can be increased by careful planting of vigorous planting stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

This soil is poorly suited to septic tank absorption fields and dwellings with or without basements because of steep and very steep slopes. This problem can be overcome by land leveling or shaping. There is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit VIe-12 and woodland suitability subclass 3s.

**Ca—Carbondale muck.** This nearly level, very poorly drained soil is on plane and concave slopes on lake

plains and in depressions in stream valleys. It is subject to frequent flooding for long periods (fig. 8). Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the upper layers are black muck about 27 inches thick. The next layer, to a depth of about 60 inches, is black mucky peat.

Included with this soil in mapping are small areas of Cathro and Markey soils that occupy similar landscape positions. These included soils are underlain by mineral soil material at a depth of 16 to 51 inches. Also included are small areas of Angelica, Pella, and Roscommon soils on the edges of depressions. They have no organic horizons. Other inclusions are small, gently sloping areas where seeps and flowing springs are common. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Carbondale soil at a moderately rapid rate. Surface runoff is ponded, and available water capacity is very high. Natural fertility is low. Organic matter content of the surface layer is very high. Roots are restricted by the seasonal water table within 1 foot of the surface.

Most areas are undrained and remain in wetland vegetation. The potential is fair for cultivated crops, hay, pasture, and trees. It is poor for most engineering uses. This soil has good potential for wetland wildlife habitat.

Where drained, this soil is moderately suited to corn, small grain, and other cultivated crops. Surface drainage is effective in removing excess surface water and both deep ditches and tile drains are effective in removing internal water where outlets are available. Drained areas are susceptible to subsidence, burning, and soil blowing. Early frost is a hazard to cultivated crops. Undrained areas are generally unsuited to common farm crops.

Unless drained this soil is generally poorly suited to hay and pasture. Reed canarygrass is one of the best plants for undrained areas. Red clover and reed canarygrass are adapted to drained areas.

This soil is suited to woodland. Wetness and the high water table during the tree planting season limits reforestation to natural regeneration. Harvest with heavy equipment is confined to when the soil is frozen. Harvest by clear-cut or area-selection methods, can reduce windthrow of the remaining trees. Competing vegetation that

*Figure 8.*—Flooding on Carbondale muck. This soil needs drainage and protection from flooding for most uses.

interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields and dwellings with or without basements because of the seasonal high water table, flooding, and low strength.

This soil is in capability unit IVw-9 drained and VIw-9 undrained. It is in woodland suitability subclass 3w.

**CbA—Casco sandy loam, 0 to 2 percent slopes.** This nearly level, well drained soil is on plane and concave slopes on outwash plains. Individual areas are irregular in shape and range from 5 to 45 acres in size.

Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsoil is dark reddish brown, friable loam about 14 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places the surface layer is loam and the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Boyer, Dresden, and Fabius soils. Boyer soils occupy similar landscape positions and have less clay in the subsoil. The Boyer soils also have a thicker and sandier subsoil. Dresden soils occupy similar landscape positions, but have a silt loam surface layer and a thicker subsoil than Casco soils. Fabius soils are somewhat poorly drained and are lower on the landscape. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Casco soil at a moderate rate and through the substratum at a very rapid rate. Surface runoff is slow. Available water capacity is low. Natural fertility is medium. Organic matter content of the surface layer is moderately low. Roots of most crops are restricted by droughty sand and gravel at a depth of 10 to 24 inches.

Most areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. It is good for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by low available water capacity. Conservation tillage, returning crop residues, and applying manure can improve soil fertility and tilth.

This soil is moderately suited to pasture and hay. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields and to dwellings with or without basements. There is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IIIs-8 and woodland suitability subclass 3s.

**CbB—Casco sandy loam, 2 to 6 percent slopes.** This gently sloping, well drained soil is on plane and convex slopes of knolls and low ridges on outwash plains. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. The subsoil is dark reddish brown, friable loam about 12 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel (fig. 9). In some places, the surface layer is loam and the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Boyer, Dresden, Fabius, and Rodman soils. Boyer and Rodman soils occupy similar landscape positions and have less clay in the subsoil than Casco. Boyer soils

*Figure 9.*—Pit exposure of Casco sandy loam, 2 to 6 percent slopes. Stratified sand and gravel is below a depth of about 23 inches. Measure is in feet.

also have more sand in the solum. Dresden soils occupy similar landscape positions, but have a silt loam surface layer and a thicker subsoil. Fabius soils are somewhat poorly drained and occupy small depressions and drainageways. Some sloping and severely eroded Casco soils are also included. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Casco soil at a moderate rate and through the substratum at a very rapid rate. Surface runoff from cultivated areas is slow. Available water capacity is low. Natural fertility is medium. Organic matter content of the surface layer is moderately low. Roots of most crops are restricted by droughty sand and gravel at a depth of 10 to 24 inches.

Most areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. It is good for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. If this soil is used for cultivated crops, there is a moderate hazard of erosion and soil blowing. Windstrips, crop rotation, conservation tillage and grassed waterways can help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure help to improve soil fertility and tilth and reduce erosion and soil blowing.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods or very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields and to dwellings with or without basements. There is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IIIe-12 and woodland suitability subclass 3s.

**CbC2—Casco sandy loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on convex slopes of broad ridges on outwash plains. Individual areas are elongated in shape and range from 3 to 40 acres in size.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. The subsoil is dark reddish brown, friable loam about 11 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places the surface layer is loam and the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Boyer and Rodman soils that occupy similar landscape positions. These soils have less clay in the subsoil. Also included are some small gently sloping and moderately steep Casco soils and severely eroded Casco soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Casco soil at a moderate rate and through the substratum at a very rapid rate. Surface runoff is medium. Available water capacity is low. Natural fertility is medium. Organic matter content of the surface layer is moderately low. Roots of most crops are restricted by droughty sand and gravel at a depth of 10 to 24 inches.

Some areas are farmed and some remain in woodland. The potential is fair for cultivated crops, hay, pasture, and trees. It is good for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, crop yields are limited by the low available water capacity. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, conservation tillage, and grassed waterways can help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve soil fertility and tilth.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by suitable herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields and to dwellings with or without basements. Slope is a problem, but it can be overcome by land leveling or shaping. There is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IVe-12 and woodland suitability subclass 3s.

**CdB—Casco-Rodman complex, 2 to 6 percent slopes.** These gently sloping, well drained and excessively drained soils are on convex slopes of knolls and low ridges on outwash plains. Individual areas of this unit are irregular in shape and range from 5 to 50 acres in size. The well drained Casco soil makes up 60 to 70 percent of the unit and the excessively drained Rodman soil makes up 20 to 30 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 7 inches thick. The subsoil is dark reddish brown, friable loam about 12 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places, the surface layer is loam and the subsoil is silty clay loam.

Typically, the surface layer of the Rodman soil is dark brown gravelly sandy loam about 7 inches thick. The subsoil is dark brown, loose gravelly sandy loam about 5 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, loose sand and gravel.

Included with these soils in mapping are small areas of Fabius soils that are somewhat poorly drained and are lower on the landscape. Included areas make up 5 to 10 percent of the unit.

Water and air move through the Casco subsoil at a moderate rate and through the substratum at a very rapid rate. Movement through the Rodman soil is very rapid. Surface runoff from cultivated areas is slow on these soils. The available water capacity is low in Casco soil and very low in Rodman soil. Natural fertility is medium in Casco soil and low in Rodman soil. The organic matter content of the surface layer is moderately low in Casco soil and low in Rodman soil. Roots of most crops are restricted by droughty sand and gravel at a depth of 10 to 24 inches in Casco soil and a depth of 8 to 15 inches in Rodman soil.

Some areas are farmed; others are in woodland. The potential is fair for cultivated crops, hay, and pasture. It is fair to poor for trees and good for most engineering uses.

These soils are moderately suited to growing corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. There is a moderate erosion hazard. Conservation tillage, crop rotations, contour farming, and grassed waterways can reduce erosion. Some areas have slopes that are long enough and smooth enough for contour stripcropping. Returning crop residues and applying manure help to prevent excessive soil loss and improve fertility and tilth.

These soils are moderately suited to pasture and hay, and their use as pasture and hayland reduces erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the plant cover and soil in good condition.

The Casco soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

The Rodman soil is poorly suited to woodland because tree growth is slow and trees tend to be poorly formed. Poor seedling survival in dry years can be partially offset by careful planting of vigorous nursery stock. Production of merchantable wood on this soil may be marginally profitable, but the trees can also control soil blowing.

These soils are suited to septic tank absorption fields and to dwellings with or without basements. There is a danger of ground water contamination by septic tank effluent. The substratum of these soils are a good source of sand and gravel.

These soils are in capability unit IIIe-12. The Casco soil is in woodland suitability subclass 3s; the Rodman soil is in 4f.

**CdC2—Casco-Rodman complex, 6 to 12 percent slopes, eroded.** These sloping, well drained and excessively drained soils are on convex slopes of broad ridges on outwash plains. Individual areas of this unit are elongated in shape and range from 3 to 15 acres in size. The well drained Casco soil makes up 55 to 65 percent of the unit and the excessively drained Rodman soil makes up about 25 to 35 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 5 inches thick. The subsoil is dark reddish brown, friable loam about 10 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places, the surface layer is loam and the subsoil is silty clay loam.

Typically, the surface layer of the Rodman soil is dark brown gravelly sandy loam about 6 inches thick. The subsoil is dark brown, loose gravelly sandy loam about 4 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, loose sand and gravel.

Included with these soils in mapping are small areas of severely eroded Casco and Rodman soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of the Casco soil at a moderate rate and through the substratum at a very rapid rate. Movement through the Rodman soil is very rapid. Surface runoff from cultivated areas is medium on these soils. The available water capacity is low in Casco soil and very low in Rodman soil. Natural fertility is medium in Casco soil and low in Rodman soil. The organic matter content of the surface layer is moderately low in Casco soil and low in Rodman soil. Roots of most crops are restricted by droughty sand and gravel at a depth of 10 to 24 inches in Casco soil and at a depth of 8 to 15 inches in Rodman soil.

Most areas are in woodland; some areas are farmed. The potential is fair to poor for cultivated crops, hay, pasture, and trees. It is good for most engineering uses.

These soils are moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low or very low available water capacity. There is a moderate erosion hazard. Conservation tillage, crop rotation, contour farming, and grassed waterways can help to control erosion. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure help to prevent excessive soil loss and improve fertility and tilth.

These soils are moderately suited to pasture and hay, and their use as pasture and hayland reduces erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during very dry periods help to keep the plant cover and soil in good condition.

The Casco soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

The Rodman soil is poorly suited to woodland because tree growth is slow and trees tend to be poorly formed. Poor seedling survival in dry years can be partially offset by careful planting of vigorous nursery stock. Production of merchantable wood on this soil may be marginally profitable but the trees can also control soil blowing.

These soils are moderately suited to septic tank absorption fields and dwellings with or without basements. Slope is a problem but it can perhaps be overcome by land leveling and shaping. There is a danger of ground water contamination by septic tank effluent. The substratum of these soils is a good source of sand and gravel.

These soils are in capability unit IVe-12. The Casco soil is in woodland suitability subclass 3s; the Rodman soil is in 4f.

**CdD2—Casco-Rodman complex, 12 to 20 percent slopes, eroded.** These moderately steep, well drained and excessively drained soils are on convex side slopes of hills and ridges on outwash plains. Individual areas of this unit are elongated in shape and range from 3 to 30 acres in size. The well drained Casco soil makes up about 50 to 60 percent of the unit and the excessively drained Rodman soil makes up about 35 to 40 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 5 inches thick. The subsoil is dark reddish brown friable loam about 9 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places, the surface layer is loam and the subsoil is silty clay loam.

Typically, the surface layer of the Rodman soil is dark brown gravelly sandy loam about 6 inches thick. The subsoil is dark brown, loose gravelly sandy loam about 3 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, loose sand and gravel.

Included with these soils in mapping are small areas of severely eroded Casco and Rodman soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of the Casco soil at a moderate rate and through the substratum at a very rapid rate. Movement through Rodman soil is very rapid. Surface runoff from cultivated areas is rapid on these soils. The available water capacity is low in Casco soil and very low in Rodman soil. Natural fertility is medium in Casco soil and low in Rodman soil. The organic matter content of the surface layer is moderately low in Casco soil and low in Rodman soil. Roots of most crops are restricted by droughty sand and gravel at a depth of 10 to 24 inches in Casco soil and at a depth of 8 to 15 inches in Rodman soil.

Most areas are in woodland; a few areas are farmed. The potential is poor for cultivated crops, pasture, and hay. It is fair to poor for trees and fair for most engineering uses.

These soils are generally unsuited to corn, small grain, and other cultivated crops. Yields in most years are limited by the low or very low available water capacity. There is a severe erosion hazard. Conservation practices are needed if these soils are cultivated. Because of the relatively small size of the areas, such practices as conservation tillage and crop rotation are the only practices that are feasible.

These soils are generally poorly suited to hay. They are, however, used for native grass pasture. Proper stocking rates, pasture rotation, and restricted use during very dry periods help to control erosion and keep the plant cover and soil in good condition.

The Casco soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

The Rodman soil is poorly suited to woodland because tree growth is slow and trees tend to be of poor form. Erosion can be reduced by contour planting of trees and careful location of skid roads. Poor survival of planted trees during dry seasons can be partially offset by careful planting of vigorous nursery stock. Production of merchantable wood on this soil may not prove profitable, but the use of trees to control soil blowing and erosion can be very effective.

These soils are poorly suited to septic tank absorption fields and dwellings with or without basements. Slope is a problem, but it can be overcome by land leveling or shaping. There is a danger of ground water contamination by septic tank effluent. The substrates of these soils are a good source of sand and gravel.

These soils are in capability unit VIe-12. The Casco soil is in woodland suitability subclass 3s; the Rodman soil is in 4f.

**Cm—Cathro muck.** This nearly level, very poorly drained soil is on plane and concave slopes in depressions on outwash plains, on till plains, and in stream valleys. It is subject to frequent flooding for long periods. Individual areas are irregular in shape and range from 3 to 75 acres in size.

Typically, the organic layers are black muck about 25 inches thick. The substratum, to a depth of about 60 inches, is gray, mottled silty clay loam in the upper part; dark reddish gray, mottled loam in the middle; and dark reddish gray silt loam in the lower part.

Included with this soil in mapping are small areas of Angelica, Bach, Carbondale, and Pella soils that occupy similar landscape positions. Angelica, Bach, and Pella soils are poorly drained and have no organic horizons. Carbondale soils formed in organic deposits more than 51 inches deep. Also included are small areas of Markey soils underlain by sandy material at a depth of 16 to 51 inches. Some small areas have marl layers at a depth of 20 to 51 inches. Included areas make up 5 to 15 percent of the unit.

Water and air move through the organic layers of this Cathro soil at a moderately rapid rate and through the

substratum at a moderately slow rate. Surface runoff is ponded, and available water capacity is very high. Natural fertility is low. Organic matter content of the surface layer is very high. Roots are restricted by the seasonal water table within 1 foot of the surface.

Most areas are undrained and remain in wetland vegetation. The potential is fair for cultivated crops, hay, pasture and trees. It is poor for most engineering uses. This soil has good potential for wetland wildlife habitat.

Where drained, this soil is moderately suited to corn, small grain, and other cultivated crops. Surface drains can help remove excess surface water; both deep ditches and tile drains can remove internal water where outlets are available. Drained areas are susceptible to subsidence, burning, and soil blowing. Early frost is also a hazard to cultivated crops. Undrained areas are generally unsuited to common farm crops.

Where drained this soil is moderately suited to hay and pasture. Reed canarygrass is the only forage crop adapted to undrained areas. Red clover and reed canarygrass are adapted to drained areas.

This soil is suited to woodland. Wetness and a high water table during the tree planting season limit reforestation to natural regeneration. Harvest with heavy equipment is limited to when the soil is frozen. Harvest by clear-cut or area-selection methods can reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields and dwellings with or without basements because of the seasonal high water table, flooding, and low strength.

This soil is in capability unit IIIw-8 drained and VIw-8 undrained. It is in woodland suitability subclass 3w.

**DrA—Dresden silt loam, 0 to 2 percent slopes.** This nearly level, well drained soil is on plane and concave slopes on outwash plains. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsoil is about 29 inches thick. It is dark yellowish brown, friable silt loam in the upper part; dark brown, firm silty clay loam and clay loam in the middle; and yellowish brown, friable gravelly loam and reddish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown loose sand and gravel.

Included with this soil in mapping are small areas of Casco, Matherton, and Waymor soils. Casco soils occupy similar landscape positions and have a sandy loam surface layer and thinner subsoil. Matherton soils occupy drainageways and depressions and are somewhat poorly drained. Waymor soils occupy landscape positions similar to the Dresden soil and are underlain by loamy glacial till. Also included are some areas of gently sloping Dresden soils. Included areas make up 5 to 10 percent of the unit.

Water and air move through the subsoil of this Dresden soil at a moderate rate and through the substratum at a very rapid rate. Surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots of most crops are restricted by droughty sand and gravel at a depth of 24 to 40 inches.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, trees, and most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. In dry years yields are limited by moderate available water capacity. Crop rotation, conservation tillage, returning crop residues, and applying manure improve soil fertility and tilth.

This soil is suited to pasture and hay. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields and dwellings with or without basements. There is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IIs-1 and woodland suitability subclass 2o.

**DrB—Dresden silt loam, 2 to 6 percent slopes.** This gently sloping, well drained soil is on plane and convex slopes of knolls and low ridges on outwash plains. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 28 inches thick. It is dark yellowish brown, friable silt loam in the upper part; dark brown, firm silty clay loam and clay loam in the middle; and yellowish brown, friable gravelly loam and reddish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and gravel.

Included with this soil in mapping are small areas of Casco, Matherton, and Waymor soils. Casco soils occupy similar landscape positions, but are shallower over sand and gravel and have more sand near the surface. Matherton soils occupy drainageways and depressions and are somewhat poorly drained. Waymor soils occupy landscape positions similar to Dresden soils but are underlain by loamy glacial till. Also included are small areas of nearly level and sloping Dresden soils. Included areas make up 5 to 10 percent of the unit.

Water and air move through the subsoil of this Dresden soil at a moderate rate and through the substratum

at a very rapid rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots of most crops are limited by the droughty sand and gravel substratum at a depth of 24 to 40 inches.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, trees, and most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. In dry years, yields are limited by the moderate available water capacity. Where cultivated, there is a slight or moderate erosion hazard. Crop rotation, conservation tillage, and grassed waterways help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure help to improve fertility and tilth and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields and dwellings with or without basements, but there is a danger of ground water contamination by septic tank effluent. The substratum of this soil is a good source of sand and gravel.

This soil is in capability unit IIe-2 and woodland suitability subclass 2o.

**FaA—Fabius loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions and drainageways on outwash plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The subsoil, about 9 inches thick, is yellowish brown, mottled, friable sandy loam in the upper part and brown, mottled, friable loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown and light gray, loose sand and gravel.

Included with this soil in mapping are small areas of Casco, Dresden, Matherton, and Mussey soils. Casco and Dresden soils are higher and are well drained. Matherton soils occupy landscape positions similiar to the Fabius soil and have loamy material to a depth of 20 to 40 inches over sand and gravel. Mussey soils are lower and are poorly drained. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Fabius soil at a moderately rapid rate and through the substratum at a very rapid rate. Surface runoff is slow. Available water capacity is low. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low. Roots of most crops are limited by the seasonal high water table at a depth of 1 to 2 feet and by the sand and gravel substratum at a depth of 12 to 20 inches.

Most areas are farmed. The potential is good for cultivated crops, hay, and pasture. It is fair for trees and most engineering uses.

Where drainage is provided, this soil is suited to corn, small grain, and other cultivated crops. Both surface drainage and tile drainage are effective in removing excess water. If tile drainage is used, a filter may be needed to keep the tile from filling with sand. Diversions and grassed waterways are used to control runoff from adjacent slopes. In dry years, when the seasonal high water table is low, yields are limited by the low available water capacity. Returning crop residues and applying manure can improve fertility and tilth.

This soil is suited to hay and pasture. Drainage increases the choice of hay and pasture forages. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. This problem can perhaps be overcome by building a filtering mount of suitable material, and by installing tile drains outside the field to lower the water table and intercept subsurface seepage from adjoining slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by lowering the seasonal high water table with tile drains placed around foundation footings and by using gravity or sump outlets.

This soil is in capability unit IIw-5 and woodland suitability subclass 3o.

**Fu—Fluvaquents.** These poorly drained and very poorly drained, nearly level alluvial soils are on plane slopes on flood plains and in depressions. They are subject to frequent flooding for long periods. Many areas of these soils are dissected by old stream channels and oxbows. Areas on floodplains are typically elongated in shape and range from 10 to 50 acres in size. In depressions they are rounded and range from 2 to 10 acres in size.

These soils have a wide range of characteristics. Texture of the surface layer ranges from silt loam to sand; in some areas it is muck. Below the surface layer are stratified sandy, loamy, and silty layers, with thin muck or marl layers in some areas.

Included with these soils in mapping are small areas of Markey, Mussey, and Udifluvent soils. The very poorly drained Markey and poorly drained Mussey soils are in similar landscape positions, but have little or no alluvial deposition. The moderately well drained and somewhat poorly drained Udifluvents are slightly higher. Included areas make up to 10 to 15 percent of the unit.

The movement of water and air through these Fluvaquents, the available water capacity, natural fertility, and organic matter content of the surface layer are too variable to rate. Surface runoff is slow to ponded. Unless drained, these soils have a water table at or near the surface much of the year. Roots are restricted by the water table.

Most areas of these soils are used for woodland, wildlife habitat, or unimproved pasture. The potential is poor for cultivated crops, hay, pasture, trees, and for most engineering uses. It is good for wetland wildlife habitat.

These soils are generally unsuited to cultivated crops because of the high water table and frequent flooding. It is not feasible to drain most areas. Where these soils can be adequately drained and protected from flooding, they are suited to cultivated crops, hay, and pasture. Where drainage is feasible, both deep ditch and tile drainage are used. Where loose sands are present, however, filters should be used to prevent sand from clogging tile lines. Ditchbanks are susceptible to cave-ins, which fill the bottom of the drainage ditch.

Because of the high water table and frequent flooding, these soils are generally poorly suited to hay and pasture. Where drained and protected from flooding, however, crops such as red clover and alfalfa can be grown. Overgrazing reduces plant cover and encourages undesirable plant species. Loss of plant cover also can result in erosion during periods of overflow. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

These soils are poorly suited to woodland. Growth is so slow and form so poor that trees are barely merchantable at best. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods can reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

These soils are poorly suited to septic tank absorption fields because of the seasonal high water table and flooding. These hazards are difficult to overcome and a more favorable site should be selected. These soils also are poorly suited to dwellings with or without basements because of the seasonal high water table and flooding.

These soils are in capability unit Vw-1. They are not assigned to a woodland suitability subclass.

**HrB—Hortonville silt loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on plane and convex slopes of hills and ridges on till plains. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 28 inches thick. It is mostly reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam. In some places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Kewaunee and Waymor soils that occupy similar landscape positions. Kewaunee soils have more clay in the lower part of the subsoil and in the substratum. Waymor soils have less clay in the lower part of the subsoil and in the substratum. Also included are some small areas of somewhat poorly drained Symco soils in drainageways and depressions. In some areas the lower part of the Hortonville subsoil is mottled. Some areas with silty or sandy strata are also included. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Hortonville soil at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate.

Most areas are farmed (fig. 10). The potential is good for cultivated crops, pasture, hay, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, grassed waterways, and contour farming help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve fertility, increase water infiltration, and prevent excessive soil loss.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. The moderate permeability of the substratum is a

problem but it can perhaps be overcome by increasing the size of the absorption field. This soil is moderately suited to dwellings with or without basements. The moderate shrink-swell potential of the subsoil is a problem that can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

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

**HrC2—Hortonville silt loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on convex slopes of broad ridges on till plains. Individual areas are elongated in shape and range from 3 to 30 acres in size.

Typically, the surface layer is a mixture of very dark grayish brown and reddish brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. It is pale brown and reddish brown, friable silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam. In some places the surface layer is silty clay loam or fine sandy loam.

Included with this soil in mapping are small areas of Kewaunee and Waymor soils that occupy similar landscape positions. Kewaunee soils have more clay in the lower part of the subsoil and in the substratum. Waymor soils have less clay in the lower part of the subsoil and in the substratum. Some gently sloping and moderately steep Hortonville soils are also included. Some areas with silty lacustrine or outwash sand strata are also included. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Hortonville soil at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is fair for cultivated crops, pasture, and hay and good for growing trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. If worked when wet, this soil tends to puddle and become compact, then when it drys it forms hard clods that make it difficult to prepare a seedbed. Crop rotation, contour farming, and grassed waterways help to prevent excessive soil loss. Some

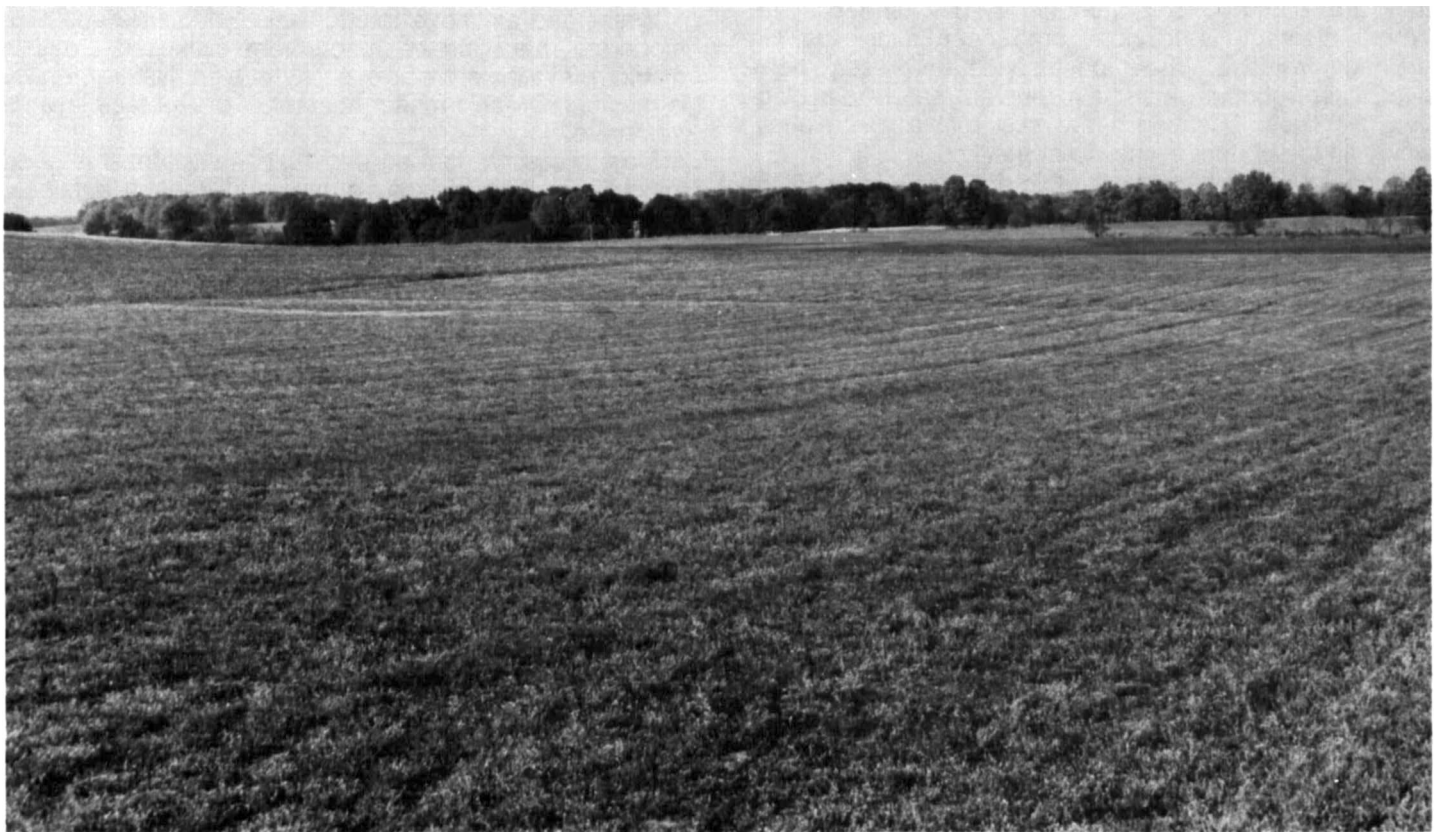

*Figure 10.*—Typical area Hortonville silt loam, 1 to 6 percent slopes. This is one of the best agricultural soils in the county.

areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve soil fertility and tilth and increase water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. The moderate permeability of the substratum and the slope are problems, but they can perhaps be overcome by enlarging the absorption field and by land leveling or shaping. This soil is moderately suited to dwellings with or without basements. The moderate shrink-swell potential of the subsoil is a problem, but it can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. Slope is a problem that can perhaps be overcome by land leveling or shaping.

This soil is in capability unit IIIe-1 and woodland suitability subclass 1o.

**HrD2—Hortonville silt loam, 12 to 20 percent slopes, eroded.** This moderately steep, well drained soil is on convex side slopes of hills and ridges on till plains. Individual areas are elongated in shape and range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown and brown silt loam about 6 inches thick. The subsoil is about 22 inches thick. It is pale brown, friable silty clay loam in the upper part and reddish brown firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam. In some places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Kewaunee and Waymor soils that occupy similar landscape positions. Kewaunee soils have more clay in the lower part of the subsoil and in the substratum. Waymor soils have less clay in the lower part of the subsoil and in the substratum. Some small areas of moderately steep and very steep Hortonville soils are also included. In some areas there are silty lacustrine or sandy outwash strata. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Hortonville soil at a moderate rate. Surface runoff from cultivated areas is rapid. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate.

Some areas are farmed; others are in woodland. The potential is fair for cultivated crops, pasture, and hay. It is good for trees. The potential is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a severe erosion hazard. If worked when wet, this soil tends to puddle and become compact, then when it drys it forms hard clods that make it difficult to prepare a seedbed. Intensive management and soil conservation measures are needed if this soil is cultivated. Contour farming, crop rotations, conservation tillage, stripcropping, diversions, and terracing can help prevent excessive soil loss. Many areas of this soil are so small that crop rotation and conservation tillage are not practical.

This soil is moderately suited to pasture and hay, and keeping it in permanent pasture and hayland reduces erosion. Overgrazing or grazing when the soil is wet, however, will cause surface compaction, excessive runoff, poor tilth, and increased erosion. Proper stocking rates, pasture rotation, and restricted use during wet periods can help keep the plant cover and soil in good condition.

This soil is suited to woodland. Soil-related problems of forest management are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest can minimize erosion. Seedling survival on steeper slopes facing south or west can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

Because of its slope, this soil is poorly suited to septic tank absorption fields and dwellings with or without basements. This problem can perhaps be overcome by land leveling or shaping. The moderate shrink-swell potential in the subsoil is a problem, but it can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IVe-1 and woodland suitability subclass 1r.

**HsB—Hortonville-Symco silt loams, 1 to 6 percent slopes.** These nearly level and gently sloping, well drained and somewhat poorly drained soils are on concave and convex slopes on till plains. Individual areas of this unit are irregular in shape and range from 10 to several hundred acres in size. The Hortonville soil is well drained and occupies the tops and sides of small knolls that are separated by the somewhat poorly drained Symco soil in depressions. Hortonville soil makes up about 45 to 60 percent of the map unit and Symco soil makes up about 35 to 50 percent of the unit. The Symco soil is subject to occassional flooding for brief periods. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Hortonville soil in the complex is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 26 inches thick. It is pale brown and reddish brown, friable silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam.

Typically, the surface layer of the Symco soil in the complex is very dark brown silt loam about 9 inches thick. The subsoil is about 19 inches thick. It is brown, mottled, firm clay loam in the upper part and reddish brown, mottled, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, mottled, friable loam.

Included with these soils in mapping are small areas of Kewaunee, Manawa, Pella, and Poygan soils. Kewaunee, Manawa, and Poygan soils have more clay in the subsoil and substraum. Pella and Poygan soils are poorly drained. Included areas make up 5 to 15 percent of the unit.

Water and air move through the Hortonville soil at a moderate rate and through the Symco soil at a moderately slow rate. Surface runoff from cultivated areas of Hortonville soil is medium and Symco soil is slow. Available water capacity of both soils is high. Natural fertility is medium. The organic matter content of the surface layer is moderate for Hortonville soil and moderate to high for Symco soil. Roots of most crops are limited in the Symco soil by the seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, pasture, hay, and trees. It is fair for most engineering uses.

These soils are suited to corn, small grain, and other cultivated crops. The Symco soil needs drainage if the soils in this complex are to dry uniformly. Tile drains work well for this purpose. There is a moderate erosion hazard on the Hortonville soil. Because of the short slopes and small areas, many conservation practices are not practical for erosion control. Conservation tillage and crop rotation, however, can help to control erosion.

These soils are suited to hay and pasture. Where the Symco soil is drained a wider variety of forage plants are adapted. Fertilization, renovation, controlled grazing, and restricted use during wet periods can help keep the soil and plant cover in good condition.

These soils are suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

The Hortonville soil is moderately suited to septic tank absorption fields. The moderately permeable substratum is a problem but it can perhaps be overcome by enlarging the absorption field. The Symco soil is poorly suited to septic tank absorption fields because of the seasonal high water table, flooding, and moderately slow permeability. The Hortonville soil is moderately suited to dwellings because of the moderate shrink-swell potential of the subsoil. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. The Symco soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. The hazard of the seasonal high water table and flooding can be avoided by selecting building sites on the adjoining Hortonville soil.

This complex is in capability unit IIe-1 and woodland suitability subclass 1o.

**HzB—Hortonville-Boyer-Zurich complex, 2 to 6 percent slopes.** These gently sloping, well drained soils are on convex slopes of hills and ridges on till plains that have been modified by wind and water. Individual areas of this unit are irregular in shape and range from 10 to 75 acres in size. Hortonville soil makes up 45 to 55 percent of the unit, and Boyer and Zurich soils each make up 10 to 20 percent of the unit. The Hortonville soil is mostly on lower side slopes of hills and ridges and the Boyer and Zurich soils are on hill and ridge crests. Areas of these soils are so intricately mixed, or so small in size, that it was not practical to separate them in mapping.

Typically, the surface layer of the Hortonville soil is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 26 inches thick. It is mostly reddish brown, friable silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam.

Typically, the surface layer of the Boyer soil is very dark grayish brown loamy sand about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 4 inches thick. The subsoil is about 22 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Typically, the surface layer of the Zurich soil is very dark brown silt loam about 7 inches thick. The subsoil is about 20 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, stratified silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Casco, Dresden, Kewaunee, Oakville, and Symco soils. Casco and Dresden soils occupy ridge crests near the Boyer soil. Casco soils have a thinner subsoil that contains more clay than the Boyer soil. Dresden soils have more clay in the subsoil than the Boyer soils. Kewaunee soils occupy lower side slopes with Hortonville soil and have more clay in the lower part of the subsoil and in the substratum. Oakville soils are on ridge crests with Boyer soil, but are sandy throughout. Symco soils occupy drain-

ageways and are somewhat poorly drained. Also included are some small areas of Hortonville-Boyer-Zurich complex, 6 to 12 percent slopes. Included areas make up about 5 percent of the unit.

Water and air move through the Hortonville soil at a moderate rate, through the subsoil of the Boyer soil at a moderately rapid rate, through the substratum of Boyer soil at a very rapid rate, and through the Zurich soil at a moderate rate. Surface runoff from cultivated areas is medium on Hortonville and Zurich soils and slow on Boyer soil. The available water capacity is high for Hortonville and Zurich soils and low for Boyer soil. The organic matter content of the surface layer is moderate in Hortonville soil, moderate to low in Boyer soil, and moderate or moderately low in Zurich soil. Natural fertility is medium in Hortonville and Zurich soils and low in Boyer soil.

Most areas are farmed. The potential is good or fair for cultivated crops, pasture, hay, trees, and most engineering uses.

These soils are moderately suited to corn, small grain, and cultivated crops. Where they are cultivated, there is a moderate erosion hazard. Suitable crop rotation, grassed waterways, and contour farming help prevent excessive soil loss. Some slopes are long enough and smooth enough for contour stripcropping and diversions. The Boyer soil is susceptible to soil blowing. Returning crop residues and applying manure improve fertility, reduce surface crusting, and increase water infiltration. Small areas of Symco soil in this complex need tile drainage and grassed waterways to remove excess water.

These soils are moderately suited to pasture and hay. Overgrazing or grazing when the soils are too wet will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep plant cover and these soils in good condition.

These soils are suited to woodland. The only soil related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

The Hortonville and Zurich soils are moderately suited to septic tank absorption fields. The moderate permeability can perhaps be overcome by enlarging the absorption field. The Boyer soil is suited to septic tank absorption fields, but there is a danger of ground water contamination. The Hortonville and Zurich soils are moderately suited to dwellings with and without basements. The moderate shrink-swell potential of the subsoil is a problem, but it can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. The Boyer soil is suited to dwellings with and without basements

This complex is in capability unit IIe-1. The Hortonville soil is in woodland suitability subclass 1o, the Boyer soil is in 3s, and the Zurich soil is in 2o.

**HzC2—Hortonville-Boyer-Zurich complex, 6 to 12 percent slopes, eroded.** These sloping, well drained soils are on convex slopes of broad ridges on till plains that have been modified by wind and water. Individual areas of this unit are irregular in shape and range from 10 to 60 acres in size. Hortonville soil makes up 45 to 55 percent of the unit and Boyer and Zurich soils each make up 10 to 20 percent of the unit. The Hortonville soil is mostly on lower side slopes of broad ridges and Boyer and Zurich soils are on ridge crests. Areas of these soils are so intricately mixed or so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Hortonville soil is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 24 inches thick. It is mostly reddish brown friable silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown firm loam.

Typically, the surface layer of the Boyer soil is dark grayish brown loamy sand about 7 inches thick. The subsurface layer is brown loamy sand about 4 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown loose sand and sand and gravel.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 6 inches thick. The subsoil is about 20 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, stratified silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Casco, Dresden, Kewaunee, Oakville, and Symco soils. Casco and Dresden soils occupy ridge crests near Boyer soil. Casco soils have a thinner subsoil that contains more clay than the Boyer soils. Dresden soils have more clay in the subsoil than the Boyer soil. Kewaunee soils occupy lower side slopes with Hortonville soil and have more clay in the lower part of the subsoil and in the substratum. Oakville soils are on ridge crests with the Boyer soil but are sandy throughout. Symco soils occur in small drainageways and are somewhat poorly drained. Also included are some small areas of Hortonville-Boyer-Zurich complex, 12 to 20 percent slopes. In a few places there is a seasonal perched water table at a depth of 2 to 5 feet. Included areas make up about 15 percent of the unit.

Water and air move through the Hortonville soil at a moderate rate, through the subsoil of the Boyer soil at a moderately rapid rate, through the substratum of the Boyer soil at a very rapid rate, and through the Zurich soil at a moderate rate. Surface runoff from cultivated areas is medium on all soils of the complex. The available water capacity is high for Hortonville and Zurich soils and low for Boyer soil. Hortonville and Zurich soils have

medium natural fertility and Boyer soil has low natural fertility. The organic matter content of the surface layer is moderate in Hortonville soil, moderate to low in Boyer soil, and moderate to moderately low in Zurich soil.

Most areas are farmed. The potential is fair for cultivated crops, pasture, and hay. It is fair to good for trees and most engineering uses.

These soils are moderately suited to corn, small grain, and adapted cultivated crops. If these soils are cultivated, there is a moderate erosion hazard. Boyer soil is susceptible to soil blowing and is droughty. Crop rotation, contour farming, and grassed waterways help to prevent excessive soil loss. Contour stripcropping and diversions reduce erosion on long smooth slopes. Returning crop residues and applying manure improve soil fertility and tilth and increase water infiltration. Included Symco soils need tile drainage and grassed waterways to remove excess water.

These soils are moderately suited to pasture and hay, and their use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help keep the soil and plant cover in good condition.

These soils are suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

These soils are moderately suited to septic tank absorption fields. Slope is a problem, but it can perhaps be overcome by land leveling and shaping. It may be necessary to increase the size of the absorption field to overcome the moderate permeability in the Hortonville and Zurich soils. There is a danger of ground water contamination by septic tank effluent in Boyer soil. These soils are moderately suited to dwellings with or without basements. Slope is a problem, but it can perhaps be overcome by land leveling or shaping. The Hortonville and Zurich soils also have a moderate shrink-swell potential in the subsoil. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This complex is in capability unit IIIe-1. The Hortonville soil is in woodland suitability subclass 1o, the Boyer soil is in 3s, and the Zurich soil is in 2o.

**HzD2—Hortonville-Boyer-Zurich complex, 12 to 20 percent slopes, eroded.** These moderately steep, well drained soils are on convex slopes of hills and ridges on till plains that have been modified by wind and water. Individual areas of this unit are irregular in shape and range from 10 to 50 acres in size. Hortonville soil makes up 35 to 45 percent of the unit, and Boyer and Zurich soils each make up 15 to 25 percent of the unit. The Hortonville soil is mostly on the lower side slopes of hills and ridges and Boyer and Zurich soils are on upper side slopes and ridge crests. Areas of these soils are so intricately mixed or so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Hortonville soil is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 24 inches thick. It is mostly reddish brown, friable silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam.

Typically, the surface layer of the Boyer soil is dark grayish brown loamy sand about 6 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 5 inches thick. The subsoil is about 18 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, stratified silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Casco, Kewaunee, and Oakville soils. Casco soils are mostly on ridge crests with Boyer soil but have a thinner subsoil that contains more clay than the Boyer soil. Kewaunee soils occupy lower side slopes of ridges with Hortonville soil and have more clay in the lower part of the subsoil and in the substratum. Oakville soils are also on the ridge crests with Boyer soils but are sandy throughout. Also included with these soils are some small areas of Hortonville-Boyer-Zurich complex, 6 to 12 percent slopes. Included areas make up about 15 percent of the unit.

Water and air move through the Hortonville soil at a moderate rate, through the subsoil of the Boyer soil at a moderately rapid rate, through the substratum of the Boyer soil at a very rapid rate, and through the Zurich soil at a moderate rate. Surface runoff from cultivated areas is rapid on all soils of the complex. The available water capacity is high for Hortonville and Zurich soils and low for Boyer soil. Hortonville and Zurich soils have a medium natural fertility. The Boyer soil has low natural fertility. The organic matter content of the surface layer is moderate in Hortonville soil, moderate to low in Boyer soil, and moderate or moderately low in Zurich soil.

Some areas are farmed; others are in woodland. The potential is fair for cultivated crops, pasture, and hay; good to fair for trees; and fair for most engineering uses.

These soils are moderately suited to corn, small grain, and other cultivated crops. If they are cultivated, there is a severe erosion hazard. The Boyer soil is susceptible to soil blowing and is droughty. Crop rotation, conservation tillage, contour farming, and grassed waterways are necessary to control erosion if these soils are cultivated.

These soils are moderately suited to pasture and hay, and maintaining them in hayland or pasture will control

erosion. Overgrazing or grazing when the soils are too wet, however, will cause surface compaction, excessive runoff, poor tilth, and increased erosion. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the soil and plant cover in good condition.

These soils are suited to woodland. Soil-related problems of forest management are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest will minimize erosion. Seedling survival on steeper slopes facing south or west can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

These soils are poorly suited to septic tank absorption fields and dwellings with or without basements because of slope. This problem can perhaps be overcome by land leveling or shaping. There is a danger of ground water contamination by septic tank effluent in Boyer soil.

This complex is in capability unit IVe-1. The Hortonville soil is in woodland suitability subclass 1r, the Boyer soil is in 3s, and the Zurich soil is in 2r.

**HzE—Hortonville-Boyer-Zurich complex, 20 to 35 percent slopes.** These steep and very steep, well drained soils are on convex side slopes of hills and ridges of till plains and moraines and on the side slopes of valleys. Individual areas of this unit are elongated in shape and range from 3 to 100 acres in size. Hortonville soil makes up 35 to 45 percent of the unit, and Boyer and Zurich soils each make up 15 to 25 percent of the unit. The Hortonville soil is on upper side slopes and ridgetops; the Boyer and Zurich soils occupy lower side slopes. Areas of these soils are so intricately mixed or so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Hortonville soil is very dark grayish brown silt loam about 6 inches thick. The subsoil is about 21 inches thick. It is reddish brown, friable silty clay loam in the upper part and reddish brown firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm loam.

Typically, the surface layer of the Boyer soil is dark grayish brown loamy sand about 6 inches thick. The subsoil is about 16 inches thick. It is dark yellowish brown, loose loamy sand in the upper part; reddish brown, friable sandy loam in the middle; and yellowish brown, very friable loamy sand in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and sand and gravel.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 5 inches thick. The subsoil is about 17 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown stratified silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Casco, Kewaunee, and Nichols soils. Casco soils occupy landscape positions similar to the Boyer soil but have a thinner subsoil that contains more clay than Boyer soil. Kewaunee soils occupy landscape positions similar to the Hortonville soil but have more clay in the lower part of the subsoil and in the substratum. Nichols soils occupy landscape positions similar to the Zurich soil but have less clay in the subsoil. Also included are small areas of somewhat poorly drained and poorly drained soils near hillside seeps and springs. Included areas make up about 15 percent of the unit.

Water and air move through the Hortonville soil at a moderate rate, through the subsoil of the Boyer soil at a moderately rapid rate, through the substratum of the Boyer soil at a very rapid rate, and through the Zurich soil at a moderate rate. Surface runoff from cultivated areas is rapid or very rapid on all soils of the complex. The available water capacity is high for Hortonville and Zurich soils and low for Boyer soil. The Hortonville and Zurich soils have medium natural fertility; Boyer soil has low natural fertility. The organic matter content of the surface layer is moderate in Hortonville soil, moderate to low in Boyer soil, and moderate or moderately low in Zurich soil.

Most areas are in woodland. The potential is poor for cultivated crops, pasture, and hay and good or fair for trees. The potential is poor for most engineering uses. It is good for woodland.

These soils are suited to woodland. Soil-related problems of forest management are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest will minimize erosion. Seedling survival on steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

Because of the slope, these soils are poorly suited to septic tank absorption fields and dwellings with and without basements. On the Boyer soil, there is a danger of ground water contamination by septic tank effluent.

This complex is in capability unit VIe-1. The Hortonville soil is in woodland suitability subclass 1r, the Boyer soil is in 3s, and the Zurich soil is in 2r.

**KhB—Kewaunee silt loam, 2 to 6 percent slopes.** This gently sloping, well drained soil is on plane and convex slopes of hills and ridges on till plains. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 20 inches thick. It is reddish brown, firm silty clay loam in

the upper part and reddish brown, firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay. In some places the slope is less than 2 percent; some areas are eroded.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Omro soils that occupy similar landscape positions. Hortonville soils have less clay in the lower part of the subsoil and in the substratum. Kolberg soils are underlain by dolomite bedrock at a depth of 20 to 40 inches. Omro soils have a loamy lower subsoil and substratum. Also included are small areas of Manawa and Poygan soils. These soils are somewhat poorly drained and poorly drained respectively and occupy drainageways and depressions. Also included are some small sloping areas of Kewaunee soils and areas of Kewaunee soil with sandy strata in the subsoil and substratum. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is high. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Conservation measures such as crop rotation and grassed waterways can help prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying barnyard manure improve fertility and tilth and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. This problem can perhaps be overcome by building a filtering mound of suitable material. This soil is poorly suited to dwellings with or without basements because of the high shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIe-6 and woodland suitability subclass 2c.

**KpB2—Kewaunee silty clay loam, 2 to 6 percent slopes, eroded.** This gently sloping, well drained soil is on convex slopes of hills and ridges on till plains. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 20 inches thick. It is reddish brown, firm silty clay loam in the upper part and reddish brown, firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay. In some places there are layers of silt and fine sand in the substratum.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Omro soils that occupy similar landscape positions. Hortonville soils have less clay in the lower part of the subsoil and in the substratum. Kolberg soils are underlain by dolomite bedrock at a depth of 20 to 40 inches. Omro soils have a loamy lower subsoil and substratum. Also included are small areas of Manawa and Poygan soils. These soils are somewhat poorly drained and poorly drained respectively and occupy drainageways and depressions. Also included are some small sloping areas of Kewaunee soils and areas of Kewaunee soils with sandy strata in the subsoil and substratum. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is high. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Care should be taken to cultivate this soil at the proper moisture content to insure good tilth. If worked when wet, this soil tends to puddle and become compacted. On drying it forms hard clods that make it difficult to prepare a seedbed. Conservation measures such as crop rotations and grassed waterways help prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure improve fertility and tilth and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. This

problem can perhaps be overcome by building a filtering mound of suitable material. This soil is poorly suited to dwellings with or without basements because of the high shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIe-6 and woodland suitability subclass 2c.

**KpC2—Kewaunee silty clay loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on convex slopes of broad ridges on till plains. Individual areas are elongated in shape and range from 3 to 50 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 19 inches thick. It is reddish brown, firm silty clay loam in the upper part and reddish brown, firm silty clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Omro soils that occupy similar landscape positions. Hortonville soils have less clay in the lower part of the subsoil and in the substratum. Kolberg soils have dolomite bedrock at a depth of 20 to 40 inches. Omro soils are loamy in the lower part of the subsoil and in the substratum. Also included are some small areas of sloping or moderately steep Kewaunee soils and areas of Kewaunee soils with sandy strata in the subsoil and substratum. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is high. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is fair for cultivated crops, hay, and pasture. It is good for trees and fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Care should be taken to cultivate this soil at the proper moisture content to insure good tilth. If worked when wet the soil puddles and becomes compacted. On drying it forms hard clods that make it difficult to prepare a good seedbed. Conservation measures such as crop rotation and grassed waterways help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve fertility and tilth and increase water infiltration.

This soil is moderately suited to pasture and hay and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good conditon.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. This problem can perhaps be overcome by building a filtering mound of suitable material. This soil is poorly suited to dwellings with or without basements because of the high shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIIe-6 and woodland suitability subclass 2c.

**KpD2—Kewaunee silty clay loam, 12 to 20 percent slopes, eroded.** This moderately steep, well drained soil is on convex slopes of hills, ridges, and valley sides on till plains. Individual areas are elongated in shape and range from 3 to 25 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 5 inches thick. The subsoil is reddish brown, firm silty clay about 18 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, firm, silty clay.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Omro soils that occupy similar landscape positions. Hortonville soils have less clay in the lower part of the subsoil and in the substratum. Kolberg soils have dolomite bedrock at a depth of 20 to 40 inches. Omro soils are loamy in the lower part of the subsoil and in the substratum. Also included are some small areas of sloping and steep Kewaunee soils and some severely eroded areas. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated areas is rapid. Available water capacity is moderate. Natural fertility is high. Organic matter content of the surface layer is moderate.

Some areas are farmed. The potential is fair for cultivated crops, pasture, and hay. It is good for trees and fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a severe erosion hazard. Care should be taken to cultivate this soil at the proper moisture content to insure good tilth. If worked when wet, this soil puddles and becomes compacted. On drying it forms hard clods that make it difficult to prepare a seedbed. Very careful management is needed to control erosion. Many areas of this unit are too small for the application of conservation practices to be practicable. Where they can be used, crop rotations, grassed waterways, contour stripcropping, diversions, and conservation tillage can help to control erosion. Returning crop residues and applying manure reduce erosion, improve fertility and tilth, and increase water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture or hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep this soil and plant cover in good condition.

This soil is suited to woodland. Erosion may be controlled by contour planting of trees and careful location of skid roads during harvest. Survival of planted trees can be increased by careful planting of vigorous nursery stock. Vegetation that competes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability and slope. These problems can perhaps be overcome by building a filtering mound of suitable material and by land leveling or shaping. This soil is poorly suited to dwellings with or without basements because of the high shrink-swell potential and slope. The shrink-swell problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. Slope can perhaps be overcome by land leveling or shaping.

This soil is in capability unit IVe-6 and woodland suitability subclass 2c.

**KsC3—Kewaunee silty clay, 6 to 12 percent slopes, severely eroded.** This sloping, well drained soil is on convex slopes of broad ridges on till plains. Individual areas are elongated in shape and range from 3 to 30 acres in size.

Typically, the surface layer is reddish brown, firm silty clay about 5 inches thick. The subsoil is reddish brown, firm silty clay about 16 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Omro soils that occupy similar landscape positions. Hortonville soils have less clay in the lower part of the subsoil and in the substratum. Kolberg soils have dolomite bedrock at a depth of 20 to 40 inches. Omro soils are loamy in the lower part of the subsoil and in the substratum. Also included are some small areas of gently sloping and moderately steep Kewaunee soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderately low. Roots are somewhat restricted by the clayey subsoil at a depth of 5 to 30 inches.

Some areas are farmed; others are reverting to trees. The potential is fair for cultivated crops, hay, and pasture. It is good for trees and fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a severe erosion hazard. Care should be taken to cultivate this soil at the proper moisture content to ensure good tilth. If worked when wet, this soil puddles and becomes compacted. On drying, it forms hard clods that make it difficult to prepare a seedbed. Conservation measures such as suitable crop rotations and grassed waterways help prevent excessive soil loss. Some areas have slopes that are long enough and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure improve the tilth, fertility, and water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, poor tilth, and erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that intereferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. This problem can perhaps be overcome by building a filtering mound of suitable material. This soil is poorly suited to dwellings with or without basements because of the high shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IVe-6 and woodland suitability subclass 2c.

**KsD3—Kewaunee silty clay, 12 to 20 percent slopes, severely eroded.** This moderately steep, well drained soil is on convex slopes of hills, ridges, and valleys on till plains. Individual areas are elongated in shape and range from 3 to 50 acres in size.

Typically, the surface layer is reddish brown, firm silty clay about 5 inches thick. The subsoil is reddish brown, firm silty clay about 15 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Omro soils that occupy similar landscape positions. Hortonville soils have less clay in the lower part of the subsoil and in the substratum. Kolberg soils have dolomite bedrock at a depth of 20 to 40 inches. Omro soils are loamy in the lower part of the subsoil and in the substratum. Also included are some areas of sloping and steep Kewaunee soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated

areas is rapid. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderately low.

Some areas of this soil are farmed; others are reverting to trees. The potential is poor for cultivated crops, hay, and pasture. It is good for trees and fair for most engineering uses.

This soil is generally unsuited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a severe erosion hazard. Because of the high clay content in the surface layer, this soil should be cultivated at proper moisture content to maintain good tilth. If worked when wet, this soil puddles and becomes compacted. On drying, it forms hard clods that interfere with the preparation of a good seedbed. Very careful management is needed to control erosion. However, most areas of this soil are so small that intensive management for cultivated crops is not practicable.

This soil is generally poorly suited to pasture and hay, but its use as pasture and hayland does reduce erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, poor tilth, and erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Erosion can be controlled by contour planting of trees and careful location of skid roads during harvest. Survival of planted trees can be increased by careful planting of vigorous nursery stock. Vegetation that competes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability and slope. These problems can perhaps be overcome by building a filtering mound of suitable material and by land leveling or shaping. This soil is poorly suited to dwellings with or without basements because of high shrink-swell potential and slope. The shrink-swell problems can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. Slope can perhaps be overcome by land leveling or shaping.

This soil is in capability unit VIe-6 and woodland suitability subclass 2c.

**KsE3—Kewaunee silty clay, 20 to 35 percent slopes, severely eroded.** This steep and very steep, well drained soil is on convex side slopes along rivers and streams and on escarpments along lakes. Individual areas are elongated in shape and range from 10 to 100 acres in size.

Typically, the surface layer is reddish brown, firm silty clay about 5 inches thick. The subsoil is reddish brown, firm silty clay about 15 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay.

Included with this soil in mapping are small areas of Hortonville soils that occupy similar landscape positions. These soils have less clay in the lower part of the subsoil and in the substratum than the Kewaunee soil. Also included are some Kewaunee soils on moderately steep slopes. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kewaunee soil at a moderately slow rate. Surface runoff from cultivated areas is very rapid. Available water capacity is medium. Natural fertility is medium, and organic matter content of the surface layer is moderately low.

Most areas are in woodland. The potential is poor for farming and most engineering uses. It is good for trees and woodland wildlife habitat.

This soil is generally unsuited to cultivated crops, pasture, and hay.

This soil is suited to woodland. Erosion may be controlled by contour planting of trees and careful location of skid roads during harvest. Survival of planted trees can be increased by careful planting of vigorous nursery stock. Vegetation that competes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

Because of the steep and very steep slopes and moderately slow permeability, this soil is poorly suited to septic tank absorption fields. This soil is also poorly suited to dwellings with or without basements because of slope and high shrink-swell potential.

This soil is in capability unit VIIe-6 and woodland suitability subclass 2c.

**KtB—Kewaunee-Manawa silt loams, 1 to 6 percent slopes.** These nearly level and gently sloping, well drained and somewhat poorly drained soils are on concave and convex slopes on till plains. Individual areas are irregular in shape and range from 10 to several hundred acres in size. The well drained Kewaunee soil is on convex slopes of knolls; the somewhat poorly drained Manawa soil is in drainageways and depressions and is subject to occasionally brief flooding. Kewaunee soil makes up about 45 to 60 percent of the map unit; Manawa soil makes up about 35 to 50 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Kewaunee soil is very dark grayish brown silt loam about 8 inches thick. The subsoil is reddish brown, firm silty clay about 21 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay.

Typically, the surface layer of the Manawa soil is very dark gray silt loam about 9 inches thick. The subsoil is about 23 inches thick. It is reddish brown, mottled, firm silty clay loam in the upper part and reddish brown, mottled, firm clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm clay.

Included with these soils in mapping are small areas of Hortonville, Pella, and Symco soils. These soils have

less clay in the subsoil and substratum than Kewaunee or Manawa soils. Some small sloping areas of Kewaunee soils are also included. Included areas make up 5 to 15 percent of the unit.

Water and air move at a moderately slow rate through the Kewaunee soil and at a slow rate through the Manawa soil. Surface runoff from cultivated areas of Kewaunee soil is medium and from Manawa soil is slow. Available water capacity is moderate. Natural fertility is high in Kewaunee soil and medium in Manawa soil. Organic matter content of the surface layer is moderate. Roots of most crops are restricted by a perched seasonal high water table at a depth of 1 to 3 feet in Manawa soil.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

These soils are suited to corn, small grain, and other cultivated crops. Drainage of the Manawa soil is needed so that both soils dry uniformly. Tile drains work well for this purpose. There is a moderate erosion hazard on the Kewaunee soil, but because of the short slopes and small areas many conservation practices would be impractical to apply for erosion control. Crop rotations and conservation tillage, however, can help to control erosion.

These soils are suited to pasture and hay. A wide variety of forage species can be grown if the Manawa soil is drained. Where the Manawa soil is undrained, it is not suited to most legumes.

These soils are suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

These soils are poorly suited to septic tank absorption fields because of the moderately slow permeability, the seasonal high water table, and flooding of Manawa soil. These problems can perhaps be overcome on the Kewaunee soil by building a filtering mound of suitable material and on the Manawa soil by installing tile drains to lower the seasonal water table and intercept seepage from surrounding slopes. The Kewaunee soil is poorly suited to dwellings with or without basements because of the high shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. The Manawa soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. Dwellings should be on the Kewaunee part of the complex.

These soils are in capability unit IIe-6 and woodland suitability subclass 2c.

**KuA—Kibbie silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions on lake plains. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is about 12 inches thick and is very dark grayish brown silt loam in the upper part and grayish brown silt loam in the lower part. The subsoil is about 15 inches thick. It is brown, mottled, friable silt loam in the upper part; yellowish brown, mottled, friable loam in the middle; and brown, mottled, friable loam in the lower part. The substratum, to a depth of about 60 inches, is pale brown, mottled, friable silt. In some places the subsoil has thin layers of clay loam, sandy loam, or silty clay loam and the substratum is stratified with thin layers of very fine sand.

Included with this soil in mapping are small areas of Kibbie Variant, Matherton, and Shiocton soils that occupy similar landscape positions. Kibbie Variant soils have more clay in the subsoil. Matherton soils are underlain by sand and gravel at a depth of 20 to 40 inches. Shiocton soils mostly have less clay in the subsoil. Also included are small areas of Bach and Zurich soils. Bach soils have less clay in the subsoil, are poorly drained, and are lower on the landscape. Zurich soils are higher on the landscape and are well drained. Included areas make up 10 to 15 percent of the unit.

Water and air move through this Kibbie soil at a moderate rate. Surface runoff is slow. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low. Roots are restricted by the seasonal high water table at a depth of 1 to 2 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to growing corn, small grain, and other cultivated crops where drainage is provided. Surface and tile drainage are effective in removing excess water. Where possible, tile lines should be placed in the subsoil because there is danger of the silt in the substratum plugging the tile. The use of filters can help overcome this problem. Diversions help to control runoff from adjacent slopes.

This soil is suited to hay and pasture. If drained, a wider variety of forage species can be grown. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. This problem can perhaps be overcome by building a filtering mound of suitable material, and by installing tile drains outside the field to lower the seasonal high water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table. This problem can perhaps be overcome by lower-

ing the seasonal high water table by placing tile drains around the foundation footings and using gravity or sump outlets.

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

**KvA—Kibbie Variant silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions on lake plains. It is subject to occasional brief flooding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 16 inches thick. It is dark brown, mottled, firm silty clay in the upper part and reddish brown, mottled, friable silty clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown silt loam and light reddish brown, friable, stratified silt and very fine sand.

Included with this soil in mapping are small areas of Kibbie, Lamartine, and Matherton soils that occupy similar landscape positions. Kibbie soils have less clay in the subsoil. Lamartine soils are underlain by loamy glacial till at a depth of 20 to 40 inches. Matherton soils are underlain by sand and gravel outwash at a depth of 20 to 40 inches. Also included are small areas of Zurich soils. Zurich soils are well drained, have less clay in the subsoil, and are higher on the landscape. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Kibbie Variant soil at a slow rate and through the substratum at a moderate rate. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content of the surface layer is moderate. Roots are restricted by the seasonal high water table at a depth of 1 to 3 feet.

Most areas of this soil are farmed. The potential is good for cultivated crops, hay and pasture, and trees. It is fair for most engineering uses.

If adequately drained, this soil is suited to corn, small grain, and other cultivated crops. Surface and tile drainage work well to remove excess water. Where tile is used, there is a danger of silt and very fine sands from the substratum plugging the tile. If possible, tile lines should be placed in the subsoil or filters used to prevent the entry of these sediments. Diversions help to control runoff from adjacent slopes.

If drained, this soil is suited to pasture and hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and flooding. These problems can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal high water table and to intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by lowering the seasonal high water table with tile drains placed around the foundation footings and using gravity or sump outlets.

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

**KwB—Kolberg silt loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained, moderately deep soil is on plane and convex slopes of hills and ridges on till plains. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is about 6 inches thick and is very dark grayish brown and pinkish gray silt loam. The subsoil is about 25 inches thick. It is mostly reddish brown, firm silty clay in the upper part and reddish brown, firm clay in the lower part. Dolomite bedrock is at a depth of about 31 inches. In some places there are thin clayey or loamy substratum layers above the dolomite.

Included with this soil in mapping are small areas of Kolberg Variant soils that occupy similar landscape positions. These soils are thinner over bedrock than the Kolberg soils. Also included are small areas of Hortonville and Kewaunee soils. These soils are underlain by glacial till. Also included are areas of sloping Kolberg soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kolberg soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is high. Organic matter content of the surface layer is moderately low. Roots are restricted by dolomite bedrock at a depth of 20 to 40 inches.

Most areas are farmed. The potential is good for crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. In dry years, yields are limited by the moderate available water capacity. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, grassed waterways, and conservation tillage help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure improve fertility and tilth and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment

of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the moderately slow permeability and depth to bedrock. These problems can perhaps be overcome by building a filtering mound of suitable material. This soil is poorly suited to dwellings with basements because of depth to bedrock. This problem can perhaps be overcome by constructing dwellings with partially exposed basements. This soil is moderately suited to dwellings without basements because of the moderate shrink-swell potential of the subsoil. This problem may be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab and by constructing footings on the bedrock.

This soil is in capability unit IIe-2 and woodland suitability subclass 2c.

**KwC2—Kolberg silt loam, 6 to 12 percent slopes, eroded.** This sloping, well drained, moderately deep soil is on convex slopes of broad ridges on till plains. Individual areas are elongated in shape and range from 3 to 50 acres in size.

Typically, the surface layer is about 5 inches thick and is very dark grayish brown and pinkish gray silt loam. The subsoil is about 23 inches thick. It is reddish brown, firm silty clay in the upper part and reddish brown, firm clay in the lower part. Dolomite bedrock is at a depth of about 28 inches. In some places thin layers of clayey or loamy substratum are above the bedrock.

Included with this soil in mapping are small areas of Hortonville, Kewaunee, and Kolberg Variant soils that occupy similar landscape positions. Hortonville and Kewaunee soils are underlain by glacial till. Kolberg Variant soils are thinner over bedrock. Also included are some moderately steep Kolberg soils and Kolberg soils that are severely eroded. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kolberg soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderately low. Roots of some crops are restricted by dolomite bedrock at a depth of 20 to 40 inches.

Most areas are farmed. The potential is fair for cultivated crops, hay, and pasture and good for trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In dry years, yields are limited by the moderate available water capacity. If this soil is cultivated, there is a moderate erosion hazard. Tilth is poor because of a moderate amount of clay in the surface layer. If worked when wet, this soil dries to form hard clods that interfere with the preparation of a good seedbed. Crop rotation, grassed waterways, and conservation tillage help prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residue and applying manure improve fertility and tilth and increase water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the depth to bedrock and moderately slow permeability. These problems can perhaps be overcome by building a filtering mound of suitable material. This soil is poorly suited to dwellings with basements because of the depth to bedrock, but this problem can be avoided by constructing dwellings with partially exposed basements. This soil is moderately suited to dwellings without basements because of the moderate shrink-swell potential of the subsoil and the slope. These problems can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab, by constructing footings on the bedrock, and by land leveling or shaping.

This soil is in capability unit IIIe-2 and woodland suitability subclass 2c.

**KxB—Kolberg Variant silt loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained, shallow soil is on plane and convex slopes of small hills on till plains. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 10 inches thick. It is mostly reddish brown, firm silty clay in the upper part and reddish brown, firm clay in the lower part. Dolomite bedrock is at a depth of about 18 inches. In places the subsoil is loam.

Included with this soil in mapping are small areas of Kolberg soils that occupy similar landscape positions. These soils are underlain by dolomite at a depth of 20 to 40 inches. Also included are some sloping Kolberg Variant soils and some small dolomite outcroppings. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Kolberg Variant soil at a moderately slow rate. Surface runoff from cultivated areas is medium. Available water capacity is low. Natural fertility is medium. Organic matter content of the surface

layer is moderately low. Roots are restricted by dolomite bedrock at a depth of 10 to 20 inches.

Most areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. It is poor for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. If this soil is cultivated, there is a moderate erosion hazard. Cultivation may also be a problem because of the shallow depth of bedrock. Crop rotation, grassed waterways, and conservation tillage help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure improve fertility and tilth and increase water infiltration.

This soil is moderately suited to a limited number of forage species, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Survival of planted trees during dry seasons can be increased by careful planting of vigorous nursery stock. Harvest by clear-cut or area-selection methods will help reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

Because of the depth to bedrock, this soil is poorly suited to septic tank absorption fields and to dwellings with basements. This soil is moderately well suited to dwellings without basements because of the depth to bedrock and moderate shrink-swell potential. These problems can perhaps be overcome for dwellings without basements by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab or constructing the foundation footings on the bedrock.

This soil is in capability unit IIIe-12 and woodland suitability subclass 3d.

**LmA—Lamartine silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in drainageways and depressions on till plains. This soil is subject to occassional very brief flooding. Individual areas in drainageways are elongated in shape and in depressions are irregular in shape. They range from 3 to 50 acres in size.

Typically, the surface layer is dark gray silt loam about 8 inches thick. The subsurface layer is brown, mottled silt loam about 5 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, very friable, mottled silt loam and the lower part is dark brown and brown, friable, mottled loam. The substratum, to a depth of about 60 inches, is light brown, massive, mottled loam.

Included with this soil in mapping are small areas of Pella and Waymor soils. Pella soils are lower on the landscape and are poorly drained. Waymor soils are well drained and are higher. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Lamartine soil at a moderate rate. Surface runoff is slow, and available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots are restricted by the seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. Adequate drainage is needed for good crop production. Surface and tile drains are effective in removing excess water. Diversions and grassed waterways are used to control runoff from adjacent slopes.

This soil is suited to pasture and hay. If drained, a wider variety of forage crops can be grown. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and flooding. These problems can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal water table and flooding. The seasonal water table problem can perhaps be overcome by placing tile drains around the foundation footings and using gravity or sump outlets.

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

**LoB—Longrie loam, 2 to 6 percent slopes.** This gently sloping, well drained, moderately deep soil is on plane and convex slopes of ridges on till plains and outwash plains. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 17 inches thick. It is dark brown and brown, very friable and friable loam in the upper part; reddish brown, firm sandy clay loam in the middle; and reddish brown, friable loam in the lower part. The substratum, about 4 inches thick, is brown, friable loam. Dolomite bedrock is at a depth of about 28 inches.

Included with this soil in mapping are small areas of Namur and Onaway soils that occupy similar landscape

positions. The Namur soils have dolomite bedrock at a depth of 5 to 12 inches. The Onaway soils are underlain by glacial till. Small areas of rock outcroppings are also included. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Longrie soil at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is moderate. The organic matter content of the surface layer is moderate or moderately low. Natural fertility is medium. Roots of most crops are restricted by dolomite bedrock at a depth of 20 to 40 inches.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. In dry years, yields are limited by the moderate available water capacity. There is a moderate erosion hazard. Crop rotation, conservation tillage, contour farming, and grassed waterways can help to control erosion. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure helps to prevent excessive soil loss, improve fertility and tilth, and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the depth to the bedrock. This problem can perhaps be overcome by building a filtering mound of suitable material. This soil is moderately suited to dwellings without basements. The depth to bedrock is a problem that can be overcome by constructing the foundation footings on the bedrock. This soil is poorly suited to dwellings with basements because of the depth to the bedrock, but this problem can be avoided by building dwellings with partially exposed basements.

This soil is in capability unit IIe-2 and woodland suitability subclass 2o.

**McA—Manawa silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions and drainageways on till plains. It is subject to occasional brief flooding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsoil is about 23 inches thick. It is reddish brown, mottled, firm silty clay loam in the upper part and reddish brown, mottled, firm clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, mottled, firm clay. In some places the surface layer is sandy loam or silty clay loam.

Included with this soil in mapping are small areas of Kewaunee and Poygan soils. Kewaunee soils are well drained and are on convex slopes. Poygan soils are poorly drained and are lower on the landscape.

Water and air move through this Manawa soil at a slow rate. Surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots are restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. Surface and tile drainage are effective in removing excess water. Diversions and grassed waterways are used to control runoff from adjacent slopes.

This soil is suited to hay and pasture. If drained, a wider variety of forages can be grown. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table, flooding, and slow permeability. These problems can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by protecting the site from flooding and by lowering the seasonal high water table with tile drains placed around the foundation footings using gravity or sump outlets.

This soil is in capability unit IIw-2 and woodland suitability subclass 2c.

**MeB—Manistee loamy fine sand, 2 to 6 percent slopes.** This gently sloping, well drained soil is on convex slopes of ridges on lake plains and till plains. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is about 23 inches thick. It is dark brown and brown, very friable fine sand in the upper part; brown, very friable fine sandy loam in the middle; and reddish brown, firm silty clay in

the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm silty clay.

Included with this soil in mapping are small areas of somewhat poorly drained Allendale soils in depressions. Some areas of Kewaunee and Oakville soils on similar landscape positions are also included. Kewaunee soils are well drained and are loamy or clayey in the upper part of the solum. Oakville soils are sandy throughout. Some sloping Manistee soils were also included. Included areas make up 5 to 15 percent of the unit.

Water and air move through the upper part of the subsoil of this Manistee soil at a rapid rate and through the lower part of the subsoil and substratum at a slow rate. Surface runoff from cultivated areas is slow. Available water capacity is moderate. Natural fertility is low. Organic matter content of the surface layer is low.

Most areas are farmed. The potential is fair for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In dry years, yields are limited by the moderate available water capacity. There is a moderate hazard of soil blowing. Crop rotation, conservation tillage, windstrips, and windbreaks can help to control soil blowing. Returning crop residues and applying manure help to control erosion and improve fertility.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion and soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the slow permeability of the substratum. This problem can perhaps be overcome by building a filtering mound of suitable material. A septic tank absorption field can function satisfactorily where the sandy subsoil is deep enough. Care should be taken, however, to insure that sewage effluent does not flow along the top of the clayey substratum into ditches or waterways. This soil is poorly suited to dwellings with or without basements because of a high shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIIe-4 and woodland suitability subclass 3o.

**Mk—Markey muck.** This nearly level, very poorly drained soil is on plane and concave slopes in depressions on outwash plains and stream valleys. This soil is frequently flooded for long periods. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, organic material extends to a depth of about 26 inches. It is black muck in the upper part and dark reddish brown muck in the lower part. The substratum, to a depth of about 60 inches, is gray, loose fine sand.

Included with this soil in mapping are small areas of Carbondale, Cathro, Mussey, and Roscommon soils that occupy similar landscape positions. Carbondale soils have organic layers more than 51 inches thick. Cathro soils are underlain by loamy material at a depth of 16 to 51 inches. Mussey soils are loamy and Roscommon soils are sandy. These soils are slightly higher than Markey soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Markey soil at a moderately rapid rate in the organic layers and at a rapid rate in the substratum. Surface runoff is very slow, and available water capacity is very high. Natural fertility is low, and organic matter content of the surface layer is very high. Roots are restricted by the seasonal high water table within 1 foot of the surface.

Most areas are undrained and remain in wetland vegetation. The potential is poor for cultivated crops, hay, and pasture. It is fair for trees and poor for most engineering uses. The potential is good for wetland wildlife habitat.

Because of frost hazard, this soil is generally poorly suited to corn, small grain, and other cultivated crops even where drained. Surface drains and deep ditches help remove excess water where outlets are available. Where tile drainage is used, the underlying loose sand may plug the tile lines unless filters are used. Drained areas are susceptible to subsidence, soil blowing, and burning.

This soil is generally poorly suited to hay and pasture. Reed canarygrass is the only adapted forage crop in undrained areas. Red clover and reed canarygrass are adapted to drained areas.

This soil is suited to woodland. Wetness and the high water table during the tree planting season limit reforestation to natural regeneration. Harvest with heavy equipment is limited to when the soil is frozen. Harvest by clear-cut or area-selection methods reduces windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields and to dwellings with or without basements, principally because of the seasonal high water table and flooding.

This soil is in capability unit IVw-7 drained and VIw-7 undrained. It is in woodland suitability subclass 3w.

**MmA—Matherton silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions and drainageways on outwash plains. Individual areas are elongated in shape and range from 3 to 30 acres in size.

Typically, the surface layer is very dark brown silt loam about 6 inches thick. The subsurface layer is grayish

brown, mottled, very fine sandy loam about 4 inches thick. The subsoil is about 17 inches thick. It is dark yellowish brown, mottled, friable fine sandy loam in the upper part; dark brown, mottled, firm clay loam in the middle; and dark brown, mottled, friable sandy loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose sand and gravel.

Included with this soil in mapping are small areas of Casco, Dresden, Fabius, and Mussey soils. Casco and Dresden soils are higher on the landscape and are well drained. Fabius soils are somewhat poorly drained and occupy similar landscape positions but have a thinner subsoil. Mussey soils are lower and are poorly drained. Also included are small areas where the depth to the substratum is more than 40 inches. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Matherton soil at a moderate rate and through the substratum at a very rapid rate. Surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots are restricted by the seasonal high water table at a depth of 1 to 2 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, and pasture and fair for trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. Drainage is beneficial for most crop production. Surface drains and tile can help remove excess water. If tile drains are used they should be placed in the subsoil where possible. If the tile is placed in the sand and gravel substratum, filters should be used to prevent sand from plugging the tile.

This soil is suited to hay and pasture. If drained, a wider variety of forages can be grown. Fertilization, renovation, controlling grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. This problem can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with and without basements because of the seasonal high water table. This problem can perhaps be overcome by lowering the seasonal water table by placing tile drains around the foundation footings and using gravity or sump outlets.

This soil is in capability unit IIw-5 and woodland suitability subclass 3o.

**MrB—Menominee loamy fine sand, loamy substratum, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on concave slopes of ridges on till plains. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 7 inches thick. The subsoil is about 35 inches thick. It is dark brown sand and brown loamy sand in the upper part and reddish brown and brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, friable loam.

Included with this soil in mapping are small areas of Hortonville, Oakville, and Waymor soils that occupy similar landscape positions. Hortonville and Waymor soils are loamy throughout. Oakville soils are sandy throughout. Also included are some small areas of a soil similar to Menominee loamy substratum that are somewhat poorly drained or moderately well drained. Some areas of sloping Menominee loamy substratum soils are also included. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Menominee soil at a moderate rate. Surface runoff is slow. Available water capacity is moderate. Natural fertility is low. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is fair for cultivated crops, pasture, and hay and good for trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the moderate available water capacity. If this soil is cultivated, there is a moderate soil blowing and erosion hazard. Crop rotation, conservation tillage, windstrips, and windbreaks help to prevent excessive soil loss. Some areas have slopes that are long enough and smooth enough for contour stripcropping. Returning crop residues and applying manure improve fertility and tilth.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion and soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields. It is moderately suited to dwellings with or without basements. The moderate shrink-swell potential of the substratum is a problem that can perhaps be overcome by replacing the lower part of the subsoil and the substratum with a layer of coarse material, such as sand and gravel.

This soil is in capability unit IIIe-4 and woodland suitability subclass 1s.

**MsB—Menominee Variant loamy fine sand, 1 to 6 percent slopes.** This nearly level and gently sloping,

well drained to excessively drained soil is on concave slopes of ridges on outwash plains. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand 9 inches thick. The subsoil is about 29 inches thick. It is strong brown, reddish yellow and pale brown, very friable and loose fine sand in the upper part and dark yellowish brown and dark brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is yellowish brown, loose gravelly sand. In some places the loamy part of the subsoil extends to a depth of more than 40 inches.

Included with this soil in mapping are small areas of Casco and Oakville soils that occupy similar landscape positions. Casco soils are loamy throughout the subsoil. Oakville soils are sandy throughout. Also included are small sloping areas of Menominee Variant soils. The included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Menominee Variant soil at a moderate rate and through the substratum at a very rapid rate. Surface runoff is slow. Available water capacity is low. Natural fertility is low. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is fair for cultivated crops, hay, and pasture. It is good for trees and most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. If this soil is cultivated, there is a moderate soil blowing and erosion hazard. Crop rotation, conservation tillage, windstrips, and windbreaks help to prevent excessive soil loss. Returning crop residues and applying manure help to decrease erosion and improve fertility and tilth.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion and soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during very dry periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields and dwellings with and without basements. There is a danger of ground water contamination by septic tank effluent. This soil is a fair source of sand.

This soil is in capability unit IIIs-4 and woodland suitability subclass 2s.

**MtA—Mosel loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions and drainageways on lake plains and till plains. It is frequently flooded for brief periods. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsoil is about 19 inches thick. It is yellowish brown, mottled, very friable sandy loam in the upper part; brown, mottled, very friable sandy loam in the middle; and reddish brown, mottled, firm silty clay loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of Manawa soils that occupy similar landscape positions. Also included are some small areas of poorly drained Poygan soils in depressions and drainageways. Manawa and Poygan soils contain more clay in the lower part of the subsoil and in the substratum. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Mosel soil at a moderately slow rate. Surface runoff is slow. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots are restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to growing corn, small grain, and other cultivated crops. Drainage is beneficial for crop production. Surface and tile drainage work well. Diversions, grassed waterways, and tiling are used to control runoff from adjacent slopes. Returning crop residues and applying manure helps to improve soil fertility and tilth.

This soil is suited to hay and pasture. If drained, a wider variety of forage crops can be grown. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table, flooding, and moderately slow permeability of the substratum. These problems can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by lowering the seasonal water table with drains placed around the foundation footings and using gravity or sump outlets.

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

**My—Mussey loam.** This nearly level, poorly drained soil is on plane and concave slopes in drainageways and

depressions on outwash plains. It is subject to frequent flooding for long periods. Individual areas are elongated in shape in drainageways and irregular in shape in depressions. They range from 5 to 50 acres in size.

Typically, the surface layer is black loam about 11 inches thick. The subsoil is about 8 inches thick. It is dark gray, firm loam in the upper part and dark grayish brown, mottled, friable gravelly loam in the lower part. The substratum, to a depth of about 60 inches, is gray gravelly sand. In some places the subsoil extends to a depth of more than 20 inches.

Included with this soil in mapping are small areas of Fabius, Matherton, and Markey soils. Fabius and Matherton soils are somewhat poorly drained and are higher on the landscape. Markey soils are very poorly drained organic soils underlain by fine sand at a depth of 16 to 51 inches. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Mussey soil at a moderate rate and through the substratum at a rapid rate. Surface runoff is very slow and available water capacity is low. The organic matter content of the surface layer is high. Natural fertility is medium. Roots are restricted by a seasonal high water table within 1.5 feet of the surface.

Most areas of this soil are undrained and remain in wetland vegetation. Some areas are farmed. The potential is fair for cultivated crops, hay, and pasture. It is poor for trees and most engineering uses. It is good for wetland wildlife habitat.

Where drainage measures are used, this soil is suited to growing corn, small grain, and other cultivated crops. Surface drainage is effective in removing excess water. Tile drainage can be effective, but there is a hazard of fine sand plugging the tile unless a suitable filter is used. Diversions and grassed waterways are used to control runoff from adjacent slopes.

If drained, this soil is suited to pasture and hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is poorly suited to woodland. Growth is so slow and form so poor that trees are barely merchantable at best. Soil wetness generally requires planting by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods will help reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

Because of the seasonal high water table and flooding this soil is poorly suited to septic tank absorption fields and dwellings with or without basements.

This soil is in capability unit IIw-6 drained and VIw-6 undrained. It is in woodland suitability subclass 4w.

**NaB—Namur loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained, very shallow soil is on convex slopes of ridges on uplands. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark brown loam about 5 inches thick. The subsoil is brown, friable loam about 2 inches thick. Dolomite bedrock is at a depth of about 7 inches (fig. 11).

Included with this soil in mapping are small areas of Kolberg Variant soils that occupy similar landscape positions. These soils have bedrock at a depth of 12 to 20 inches. Also included are some small areas where dolomite bedrock is exposed at the surface. Included areas make up 10 to 15 percent of the unit.

Water and air move through this Namur soil at a moderate rate. Surface runoff is slow. Available water capacity is very low. Natural fertility is low, and organic matter content of the surface layer is moderate. Roots are restricted at a depth of 5 to 12 inches by the dolomite.

Most areas are in woodland. The potential is poor for farming and most engineering uses because of the very shallow depth to dolomite bedrock. It is poor for tree growth. This soil does, however, have value for aesthetics and wildlife habitat. It is also a good source of limestone for crushing.

This soil is poorly suited to woodland. The slow growth and poor shape of the trees limit production. The use of equipment is limited because the soil is too shallow for machine planting. The mortality rate of planted trees can be reduced by careful planting of vigorous nursery stock. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees.

This soil is poorly suited to septic tank absorption fields and to dwellings with or without basements because of the very shallow depth to bedrock.

This soil is in capability unit VIs-7 and woodland suitability subclass 4d.

**NrD—Namur-Rock outcrop complex, 6 to 20 percent slopes.** This sloping and moderately steep, well drained soil is on convex slopes adjacent to escarpments of dolomite bedrock. Individual areas are elongated in shape and range from 3 to 20 acres in size. Namur soil makes up 50 to 60 percent and Rock outcrop 35 to 45 percent of the unit. Areas of Namur soil and Rock outcrop are so intricately mixed, or so small in size, that it was not practical to separate them in mapping.

Typically, the surface layer of the Namur soil is very dark brown loam about 5 inches thick. The subsoil is brown, friable loam about 2 inches thick. Dolomite bedrock is at a depth of about 7 inches.

The Rock outcrop portion of this map unit consists of dolomite bedrock escarpments.

Included with this complex in mapping are small areas of Kolberg Variant soils that are underlain by dolomite bedrock at a depth of 12 to 20 inches. Also included are talus slopes immediately below dolomite escarpments. Included areas make up 10 to 15 percent of the unit.

*Figure 11.*—Bulldozed area reveals the dolomite that underlies Namur soil at a shallow depth and restricts its use for farming and homebuilding.

Water and air move through the Namur soil at a moderate rate. Surface runoff is medium on Namur soil. The available water capacity is very low in Namur soil. Natural fertility is low and organic matter content of the surface layer is moderate in Namur soils. Roots are restricted by bedrock at a depth of 5 to 12 inches.

Rock outcrop is not rated for soil properties or qualities.

Most areas of this complex are in woodland. The potential is poor for farming and most engineering uses because bedrock is near the surface. It is also poor for trees. This complex does, however, have value for aesthetics and wildlife habitat. It is a good source of stone for crushing.

This complex is poorly suited to woodland. Slow growth and poor shape of the trees limit production. Use of equipment is limited by shallow soil depth and steepness of slope. Hand planting, contour planting, and careful location of access roads can offset trafficability problems and aid in erosion control. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees.

Because bedrock is near the surface, this complex is poorly suited to septic tank absorption fields and for dwellings with or without basements.

The Namur soil is in capability unit VIIs-7 and woodland suitability subclass 4d. Rock outcrop is not assigned to a capability unit or woodland suitability subclass.

**NxB—Nichols fine sandy loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on plane and convex slopes of low ridges on lake plains. Individual areas are irregular in shape and range from 3 to 20 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is about 20 inches thick. It is dark brown, very friable fine sandy loam in the upper part; dark yellowish brown, friable very fine sandy loam in the middle; and dark brown, friable silt loam in the lower part. The upper part of the substratum, about 27 inches thick, is yellowish brown, very friable very fine sand. The lower part of the substratum, to a depth of about 60 inches, is yellowish brown, stratified silt and very fine sand.

Included with this soil in mapping are small areas of Boyer, Kibbie, Shiocton, and Zurich soils. Boyer and Zurich soils occupy landscape positions similar to those of the Nichols soil. Boyer soils are underlain by sand and gravel. Zurich soils have more clay in the subsoil than Nichols soils. Kibbie and Shiocton soils are on lower slopes and are somewhat poorly drained. Also included are some small areas of sloping Nichols soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Nichols soil at a moderate rate. Surface runoff is slow, and available water capacity is moderate. Natural fertility is medium, and organic matter content of the surface layer is moderately low.

Most areas are farmed. The potential is good for cultivated crops, pasture, hay, and trees. It is fair to good for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there are moderate erosion and soil blowing hazards. Crop rotation and grassed waterways can help prevent soil erosion and blowing. Contour stripcropping is also effective in reducing erosion on long slopes. Returning crop residues and applying manure improve soil fertility and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion and soil blowing. Overgrazing, however, will cause excessive runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing will help keep this soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. The moderate permeability of the subsoil is a problem that can perhaps be overcome by enlarging the absorption field. This soil is suited to dwellings with or without basements.

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

**OaB—Oakville loamy fine sand, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on convex slopes of beach ridges and low sand dunes on lake plains. Individual areas are irregular or elongated in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 10 inches thick. The subsoil is about 16 inches thick. It is brown and strong brown, loose fine sand in the upper part and reddish yellow, loose fine sand in the lower part. The substratum, to a depth of about 60 inches, is reddish yellow, loose fine sand.

Included with this soil in mapping are small areas of Manistee, Menominee loamy substratum, and Menominee Variant soils that occupy similar landscape positions. Manistee soils are clayey in the lower part of the subsoil and in the substratum. Menominee loamy substratum soils have loamy till below a depth of 20 to 40 inches. Menominee Variant soils have a sandy layer underlain by a loamy layer, underlain by gravelly sand outwash. Also included are areas of steeper Oakville soils and some small areas where the seasonal high water table is at a depth of 3 to 5 feet. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Oakville soil at a rapid rate. Surface runoff is slow. Available water capacity is low. Natural fertility is low, and organic matter content of the surface layer is moderately low or low.

Some areas are farmed. The potential is fair for cultivated crops, hay, and pasture. It is fair for trees and good for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. There is a moderate soil blowing hazard. Crop rotation, conservation tillage, windstrips, and windbreaks can help to control soil blowing. Returning crop residue and applying manure help to decrease erosion and soil blowing and improve fertility.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion and soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the plant cover and soil in good condition.

This soil is poorly suited to woodland because tree growth is slow and trees tend to be poorly formed. Poor seedling survival rates in dry years can be partially offset by careful planting of vigorous nursery stock. Production of merchantable wood on this soil may be marginally profitable, but the use of trees to control soil blowing can be very effective.

This soil is suited to septic tank absorption fields and dwellings with or without basements. There is a danger of ground water contamination by septic tank effluent. This soil is a good source of sand.

This soil is in capability unit IVs-4 and woodland suitability subclass 4s.

**OaC—Oakville loamy fine sand, 6 to 12 percent slopes.** This sloping, well drained soil is on convex slopes of beach ridges and sand dunes on lake plains. Individual areas are elongated in shape and range from 3 to 50 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 7 inches thick. The subsoil is about 15 inches thick. It is brown and strong brown in the upper part and reddish yellow in the lower part. It is loose, fine sand throughout. The substratum, to a depth of 60 inches, is reddish yellow, loose fine sand.

Included with this soil in mapping are small areas of Manistee, Menominee loamy substratum, and Menominee Variant soils that occupy similar landscape positions. Manistee soils are clayey in the lower part of the

subsoil and substratum. Menominee loamy substratum soils have loamy till below a depth of 20 to 40 inches. Menominee Variant soils have a sandy layer underlain by a loamy layer, underlain by gravelly sand outwash. Also included are areas of gently sloping and moderately steep Oakville soils and severely eroded Oakville soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Oakville soil at a rapid rate. Surface runoff from cultivated areas is medium. Available water capacity is low. Natural fertility is low, and organic matter content of the surface layer is low or moderately low.

Some areas are farmed; others are in woodland. The potential is poor for cultivated crops, hay, and pasture. It is fair for trees and good for most engineering uses.

This soil is generally suited to corn, small grain, and other cultivated crops. In most years, yields are limited by the low available water capacity. There is a moderate soil blowing hazard. Crop rotation, conservation tillage, windstrips, and windbreaks can help to control erosion and soil blowing. Returning crop residues and applying manure help to decrease erosion and soil blowing and improve fertility.

This soil is generally poorly suited to pasture and hay, but its use as pasture and hayland reduces erosion and soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the plant cover and soil in good condition.

This soil is poorly suited to woodland because tree growth is slow and trees tend to be poorly formed. Poor seedling survival rates in dry years can be partially offset by careful planting of vigorous nursery stock. Production of merchantable wood on this soil may be marginally profitable, but the use of trees to control soil blowing can be very effective.

This soil is moderately suited to septic tank absorption fields and dwellings with or without basements. Slope is a problem, but it can perhaps be overcome by land leveling or shaping. There is a danger of ground water contamination by septic tank effluent. This soil is a good source of sand.

This soil is in capability unit VIs-4 and woodland suitability subclass 4s.

**OdB—Omro silt loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on concave slopes of hills and ridges on till plains. Individual areas are elongated in shape and range from 3 to 80 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. It is mostly reddish brown, firm clay in the upper part and reddish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Included with this soil in mapping are small areas of Hortonville and Kewaunee soils that occupy similar landscape positions. Hortonville soils have less clay in the subsoil than the Omro soils. Kewaunee soils have a clayey substratum. Also included are areas of sloping Omro soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Omro soil at a slow rate and through the substratum at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is high. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, contour farming, and grassed waterways help prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the slow permeability of the subsoil. This problem can perhaps be overcome by building a filtering mound of suitable material or by constructing the filter field in the loamy substratum. This soil is poorly suited to dwellings with and without basements because of the moderate shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIe-6 and woodland suitability subclass 2c.

**OeC2—Omro silty clay loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on concave slopes of broad ridges on till plains. Individual areas are elongated in shape and range from 5 to 30 acres in size.

Typically, the surface layer is dark brown silty clay loam about 5 inches thick. The subsoil is about 20 inches thick. It is reddish brown, firm clay in the upper part and reddish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Included with this soil in mapping are small areas of Hortonville and Kewaunee soils that occupy similar landscape positions. Hortonville soils have less clay in the subsoil. The Kewaunee soils have clayey substratums. Also included are some small areas of gently sloping Omro soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Omro soil at a slow rate and through the substratum at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is high, and organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is fair for cultivated crops, hay, and pasture and good for trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. The tilth of this soil is poor, because clay from the upper part of the subsoil has been mixed with the surface layer by tillage. Tillage during periods of high moisture content causes compaction and increases runoff. Crop rotation and grassed waterways can help to prevent excessive soil loss. Some slopes are long and smooth enough for stripcropping and diversions. Returning crop residues and applying manure help to improve fertility, tilth, and water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, rotation of pastured areas, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the slowly permeable subsoil. This problem can perhaps be overcome by constructing a filtering mound of suitable material or by placing the filter field in the loamy substratum. This soil is moderately suited to dwellings with or without basements. The moderate shrink-swell potential and slope are problems that can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab and by land leveling and shaping.

This soil is in capability unit IIIe-6 and woodland suitability subclass 2c.

**OhB—Onaway loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on plane and convex slopes of knolls on till plains. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark brown, friable loam in the upper part; pinkish gray, friable sandy loam in the middle; and reddish brown, friable loam in the lower part. The substratum, to a depth of about 60 inches, is light reddish brown sandy loam.

Included with this soil in mapping are small areas of Angelica and Solona soils in depressions and small drainageways. Angelica soils are poorly drained and Solona soils are somewhat poorly drained. Also included are some small areas of sloping Onaway soils and areas where the water table is at a depth of 3 to 5 feet. Included areas make up 5 to 10 percent of the unit.

Water and air move through this Onaway soil at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low.

Most areas are farmed. The potential is good for cultivated crops, pasture, hay, and trees. It is good for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, conservation tillage, contour farming, and grassed waterways help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure improve fertility, reduce crusting, and control erosion.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. The moderate permeability is a problem that can perhaps be overcome by enlarging the absorption field. This soil is suited to dwellings with or without basements.

This soil is in capability unit IIe-1 and woodland suitability subclass 2o.

**OhC2—Onaway loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on convex side slopes of broad ridges on till plains. Individual areas are elongated in shape and range from 3 to 40 acres in size.

Typically, the surface layer is grayish brown loam about 7 inches thick. The subsoil is about 18 inches thick. It is dark brown, friable loam in the upper part; pinkish gray, friable sandy loam in the middle; and reddish brown, friable loam in the lower part. The substra-

tum, to a depth of about 60 inches, is light brown sandy loam.

Included with this soil in mapping are small areas of gently sloping and moderately steep Onaway soils. Included areas make up 2 to 5 percent of the unit.

Water and air move through this Onaway soil at a moderate rate. Surface runoff from cultivated areas is medium or rapid. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderately low or moderate.

Most areas are farmed. The potential is fair for cultivated crops, pasture, and hay. It is good for trees and most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, conservation tillage, contour farming, and grassed waterways help prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure improve fertility, reduce crusting and erosion, and increase water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. The slope and moderate permeability of the substratum are problems that can perhaps be overcome by enlarging the absorption field and by leveling or shaping the land. This soil is moderately suited to dwellings with or without basements. Slope is a problem but it can perhaps be overcome by land leveling or shaping.

This soil is in capability unit IIIe-1 and woodland suitability subclass 2o.

**Pe—Pella silt loam.** This nearly level, poorly drained soil is on plane and concave slopes in depressions on till plains. It is subject to occassional flooding for brief periods. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black silt loam about 14 inches thick. The subsoil is about 16 inches thick. It is dark gray, friable silt loam in the upper part and gray, friable loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, mottled, firm loam. In some places the surface layer is muck up to 16 inches thick.

Included with this soil in mapping are small, higher areas of Lamartine and Symco soils. Lamartine and Symco soils are somewhat poorly drained. Small lower areas of Cathro soil are also included. Cathro soils have 16 to 51 inches of organic material over loamy material. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Pella soil at a moderate rate. Surface runoff is very slow. Available water capacity is high. Natural fertility is high. Organic matter content of the surface layer is high. Roots are restricted by a seasonal high water table at a depth of 0 to 2 feet.

Some areas are farmed; others remain in wetland vegetation. The potential is good for cultivated crops, hay, and pasture. It is poor for trees and most engineering uses. It is good for wetland wildlife habitat.

If drained, this soil is suited to corn, small grain, and other cultivated crops. Surface and tile drainage are effective in removing excess water (fig. 12). There is a hazard of tile filling with silt if they are placed in the silty upper part of this soil. This can be prevented by placing a suitable filter over the tile. Diversions help control runoff from adjacent slopes.

This soil is suited to pasture and hay if drained. Fertilization, renovation, controlled grazing, and restricted use during wet periods help keep this soil and plant cover in good condition.

This soil is poorly suited to woodland. Growth is so slow and form so poor that trees are barely merchantable at best. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields and dwellings with and without basements because of the seasonal high water table and flooding.

This soil is in capability unit IIw-1 drained and VIw-1 undrained. It is in woodland suitability subclass 4w.

**Pg—Pits, gravel.** These are areas where sand and gravel or, in a few places, glacial till has been removed. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the material in the bottom and sides of these pits is stratified sand and gravel or sandy loam or loam glacial till.

Included with this unit in mapping are areas of spoil, which includes soil pushed from the area before excavation and piles of material that was discarded because it did not contain enough gravel or for some other reason. Also included are stones or boulders too large to crush.

Soil material associated with pits is typically sandy or loamy and is droughty. Other soil properties are too variable to rate.

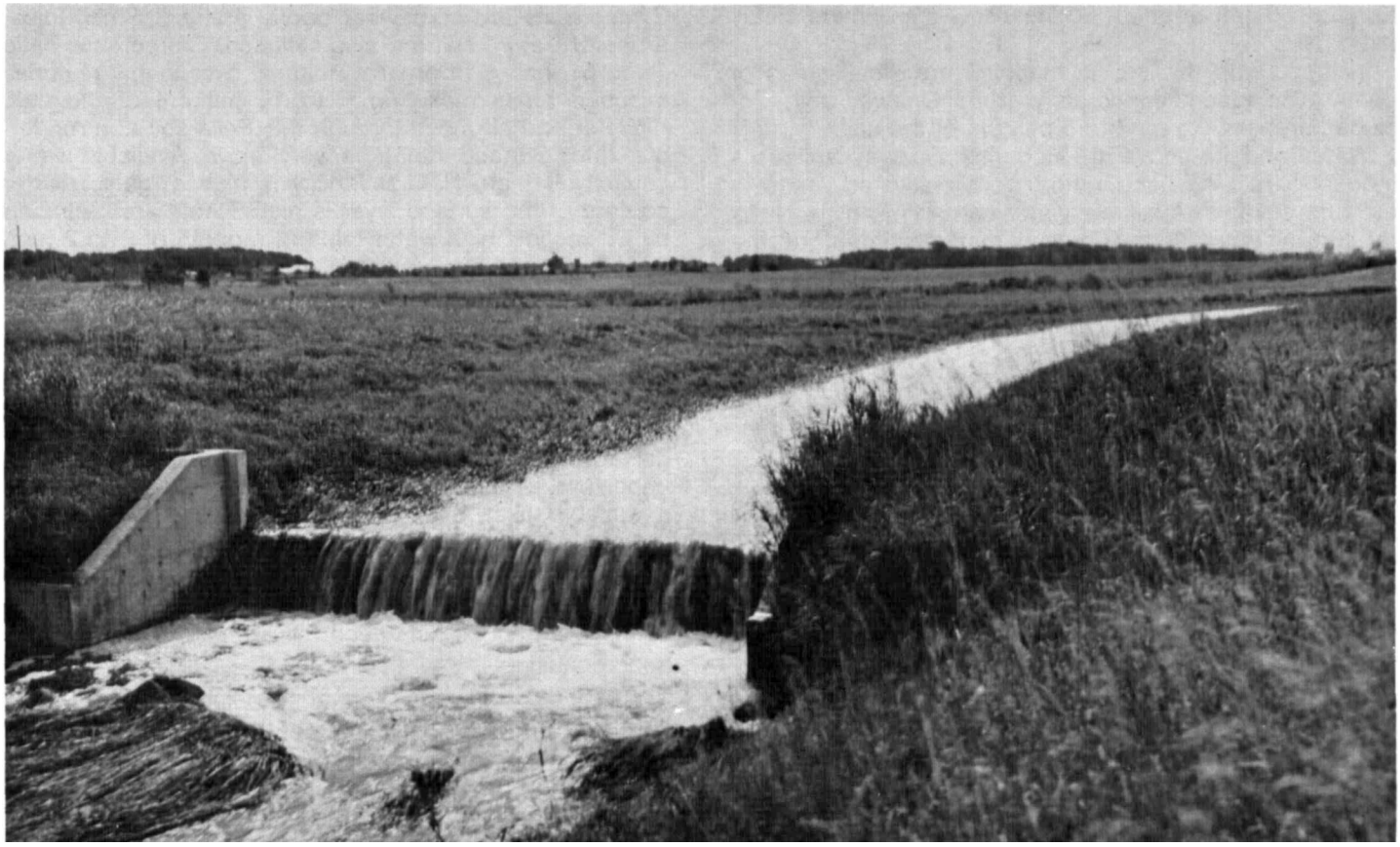

*Figure 12.*—Grassed waterway and grade stabilization structure remove surface water from Pella silt loam.

Many pits are still in use and others have been abandoned to brush and weeds. Some abandoned pits are filled with water.

The potential is poor for cultivated crops, pasture, trees, and most engineering uses. The main concern of management is reclamation of the area after excavation. To support plants, most areas require land shaping and the addition of suitable topsoil. The suitability of pits for septic tank absorption fields and dwellings with or without basements should be determined only after onsite investigation. Where slope is not a factor, pits generally are suited to septic tank absorption fields, but there is a danger of ground water contamination from sewage effluent. Small pits may be suitable for dwellings with or without basements.

Pits, gravel, are not assigned to a capability unit or a woodland suitability subclass.

**Po—Poygan silty clay loam.** This nearly level, poorly drained soil is on plane and concave slopes in depressions on lake plains and till plains. It is subject to frequent flooding for long periods. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 9 inches thick. The subsoil is about 18 inches thick. It is dark gray, firm silty clay in the upper part and reddish brown, mottled, firm clay in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, firm clay. In some places the surface layer is muck up to 16 inches thick; in other places it is silt loam.

Included with this soil in mapping are small areas of Cathro, Manawa, and Pella soils. Manawa soils are somewhat poorly drained and are higher on the landscape. Cathro soils have 16 to 51 inches of organic material over a loamy substratum and are lower. Pella soils occupy landscape positions similar to the Poygan soil, but have a loamy substratum. Also included are soils that have 20 to 40 inches of clay over sand or sand and gravel. Other inclusions are Poygan soils that have a silty clay surface layer. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Poygan soil at a slow rate. Surface runoff is very slow. Available water capacity is moderate. Natural fertility is high, and organic matter content of the surface layer is high. Roots are restricted

by a seasonal high water table within a foot of the surface.

Some areas are farmed; others remain in wetland vegetation. The potential is good for cultivated crops, hay, pasture, and trees. It is poor for most engineering uses. It is good for wetland wildlife habitat.

Where drainage is provided, this soil is suited to corn, small grain, and other cultivated crops. Surface and tile drainage are effective in removing excess water. Diversions and grassed waterways are used to control runoff from adjacent slopes.

If drained, the soil is suited to pasture and hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep this soil and plant cover in good condition.

This soil is suited to woodland. Soil wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of slow permeability, the seasonal high water table, and flooding. It is poorly suited to dwellings because of the seasonal high water table and flooding.

This soil is in capability unit IIw-1 drained and VIw-1 undrained. It is in woodland suitability subclass 2w.

**RcE—Rodman-Casco complex, 20 to 35 percent slopes.** These steep and very steep, well drained and excessively drained soils are on convex side slopes of eskers and kames and steep side slopes of morainic hills and ridges. Individual areas of this unit are elongated in shape and range from 5 to 30 acres in size. The excessively drained Rodman soil makes up about 40 to 60 percent of the unit and the well drained Casco soil makes up about 30 to 50 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Rodman soil is dark brown gravelly sandy loam about 6 inches thick. The subsoil is dark brown, loose gravelly sandy loam about 3 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, loose coarse and very coarse sand and gravel.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 5 inches thick. The subsoil is dark reddish brown, friable loam about 8 inches thick. The substratum, to a depth of about 60 inches, is loose sand and gravel.

Included with these soils in mapping are small areas of severely eroded Casco and Rodman soils. Also included are some areas of Rodman-Casco complex where the slope is less than 20 percent or more than 35 percent. Some small areas of Boyer soils are also included. These Boyer soils are deeper over sand and gravel than the Casco and Rodman soils. Included areas make up 10 to 15 percent of the unit.

Water and air move through the Rodman soil at a very rapid rate, through the subsoil of the Casco soil at a moderate rate, and through the substratum of the Casco soil at a very rapid rate. Surface runoff from cultivated areas is rapid. The available water capacity is very low in Rodman soil and low in Casco soil. Natural fertility is low in Rodman soil and medium in Casco soil. The organic matter content of the surface layer is very low in Rodman soil and low in the Casco soil. Roots of many plants are restricted by droughty sand and gravel at a depth of 8 to 15 inches in Rodman soil and at a depth of 10 to 24 inches in Casco soil.

Most areas are in woodland. The potential is poor for farming and fair to poor for trees. It is poor for most engineering uses.

The Rodman soil is poorly suited to woodland because tree growth is slow and trees tend to be of poor form. Erosion can be reduced by contour planting and by careful location of skid roads. Poor survival rates of planted trees during dry seasons can be offset by careful planting of vigorous nursery stock. Production of merchantable wood on this soil may not prove profitable, but the use of trees to control soil blowing and erosion can be very effective.

The Casco soil is suited to woodland. Erosion can be controlled by contour planting of trees and careful location of skid roads during harvest. Survival of planting trees can be increased by careful planting of vigorous nursery stock. Vegetation that competes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

Because of the slope, these soils are poorly suited to septic tank absorption fields and dwellings with and without basements. There is a danger of ground contamination by septic tank effluent. The substratum of these soils is a good source of sand and gravel.

This complex is in capability unit VIIs-7. The Rodman soil is in woodland suitability subclass 4f; the Casco soil is in 3s.

**Rs—Roscommon mucky loamy sand.** This nearly level, poorly drained and very poorly drained soil is on plane slopes in depressions on lake plains and outwash plains. It is subject to frequent flooding for brief periods. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black, mucky loamy sand about 9 inches thick. The substratum, to a depth of about 60 inches, is dark gray, loose loamy sand in the upper part and dark grayish brown, loose sand in the lower part. In some places the surface layer is loamy sand, sand, mucky sand, or sandy loam. In some places there are stratified silt and clay layers below a depth of 40 inches.

Included with this soil in mapping are small areas of Markey, Mussey, and Wainola soils. Markey soils have 16 to 51 inches of organic material over fine sand. Mussey soils have more clay in the subsoil and have a gravelly sand substratum. Wainola soils are somewhat poorly drained and are higher on the landscape. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Roscommon soil at a rapid rate. Surface runoff is very slow. Available water capacity is low. Natural fertility is low. Organic matter content of the surface layer is high. Roots are restricted by a seasonal high water table within a foot of the surface.

Some areas are farmed; others remain in wetland vegetation. The potential is fair for cultivated crops, hay, and pasture. It is poor for trees and most engineering uses. It is good for wetland wildlife habitat.

If drained, this soil is moderately suited to corn, small grain, other cultivated crops, and hay. Surface drainage and deep ditches can remove excess water. In drainage ditches, there is a problem of ditchbanks caving in and sand filling the bottom of the ditch. Tile drainage is not recommended because of the hazard of tile filling with sand. This problem can be overcome, however, by placing a suitable filter over the tile. Diversions help to control runoff from adjacent slopes. Dikes help to control flooding.

This soil is moderately suited to pasture and hay, if drained. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is poorly suited to woodland. Growth is so slow and form so poor that trees are barely merchantable at best. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields and dwellings with or without basements because of the seasonal high water table and flooding.

This soil is in capability unit IVw-6 drained and VIw-6 undrained. It is in woodland suitability subclass 4w.

**Ru—Ruse loam.** This nearly level, poorly drained, shallow soil is on plane slopes in depressions on till plains. It is subject to frequent flooding for brief periods. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is very dark brown and very dark gray loam about 9 inches thick. The subsoil is about 5 inches thick. It is gray, friable fine sandy loam in the upper part and brown, mottled, very friable loamy fine sand in the lower part. Dolomite bedrock is at a depth of about 14 inches.

Included with this soil in mapping are small areas of Bonduel soils. Bonduel soils are somewhat poorly drained, have bedrock at a depth of 20 to 40 inches, and are higher on the landscape. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Ruse soil at a moderate rate. Surface runoff is very slow. Available water capacity is very low. Natural fertility is medium. Organic matter content of the surface layer is high. Roots of most crops are restricted by the seasonal high water table within 6 inches of the surface and by dolomite bedrock at a depth of 10 to 20 inches.

Most areas are used for native grass pasture, wetlands, and wildlife habitat. A few areas are used for farming. The potential is fair for cultivated crops, hay, and pasture. It is poor for trees and most engineering uses. It is good for wetland wildlife habitat.

If drained, this soil is moderately suited to corn, small grain, and other cultivated crops. Dolomite bedrock at a shallow depth limits the use of drainage practices and limits the choice of pasture and hay plants to those that will tolerate some wetness.

This soil is poorly suited to woodland. Growth is so slow and form so poor that trees are barely merchantable at best. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields and dwellings with or without basements because of the seasonal high water table, flooding, and shallow depth to bedrock.

This soil is in capability unit IIIw-6 drained and VIw-6 undrained. It is in woodland suitability subclass 4w.

**ShA—Shiocton silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions on lake plains. It is subject to occassional flooding for long periods. Individual areas are irregular in shape and range from 3 to 80 acres in size.

Typically, the surface layer is black silt loam about 9 inches thick. The subsoil is about 16 inches thick. It is light yellowish brown and light brown, mottled, very friable silt loam in the upper part and light reddish brown, mottled, very friable stratified silt and very fine sand in the lower part. The substratum, to a depth of about 60 inches, is light reddish brown, mottled, very friable stratified silt and very fine sand. In some places the subsoil has layers of fine sandy loam.

Included with this soil in mapping are small areas of Kibbie, Lamartine, and Wainola soils that occupy similar landscape positions. Kibbie soils typically have more clay in the subsoil. Lamartine soils have loamy glacial till at a depth greater than 30 inches. Wainola soils are sandy throughout. Also included are some areas of Bach and Nichols soils. The poorly drained Bach soils are lower on the landscape. The well drained Nichols soils are higher. Included areas make up 10 to 15 percent of the unit.

Water and air move through this Shiocton soil at a moderate rate. Surface runoff is slow. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate. Roots of most crops are restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. More dependable crop production is obtained where drainage is provided. Surface drainage and deep ditches are effective in removing excess water. Where deep ditches are used, there is a hazard of silt and very fine sand filling the drainage ditches. Ditchbanks should be stabilized with vegetation if possible to overcome this problem. Tile drainage is not recommended because of the tendency of silt and very fine sand to plug tile. This problem can be overcome by using a suitable filter over the tile. Diversions and grassed waterways are used to control runoff from adjacent slopes.

This soil is suited to pasture and hay. Surface drainage, fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and flooding. These problems can perhaps be overcome by building a filtering mound of suitable material, and by installing tile drains outside the field to lower the seasonal high water table and intercept subsurface seepage from surrounding slopes. A suitable filter should be placed over the tile to avoid plugging by silt and very fine sand. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by lowering the seasonal water table by placing tile drains around the foundation footings and using gravity or sump outlets. Tile should be covered with a suitable filter to avoid plugging with silt and very fine sand.

This soil is in capability unit IIw-4 and woodland suitability subclass 2o.

**SoA—Solona silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions on till plains. It is subject to occassional flooding for brief periods. Individual areas are irregular in shape and range from 3 to 100 acres in size.

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

Included with this soil in mapping are small areas of Angelica, Bonduel, and Onaway soils. Angelica soils are lower on the landscape and are poorly drained. Bonduel soils are underlain by dolomite bedrock at a depth of 20 to 40 inches. Onaway soils are higher and are well drained. Included areas make up 5 to 10 percent of the unit.

Water and air move through this Solona soil at a moderate rate. Surface runoff is slow. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low. The roots of many crops are restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is fair for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops where drainage is provided. Surface and tile drainage are effective in removing excess water. Diversions and grassed waterways are used to control runoff from adjacent slopes.

The soil is suited to hay and pasture. If drained, more dependable forage yields can be obtained. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and flooding. These problems can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by lowering the seasonal water table by placing tile drains around the foundation footings and using gravity or sump outlets.

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

**SyA—Symco silt loam, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is on plane and concave slopes in depressions and

drainageways on till plains. It is subject to occassional flooding for brief periods. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is about 19 inches thick. It is brown, mottled, firm clay loam in the upper part and reddish brown, mottled, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is reddish brown, mottled, friable loam.

Included with this soil in mapping are small areas of Hortonville, Manawa, and Pella soils. Hortonville soils are higher on the landscape and are well drained. Manawa soils occupy landscape positions similar to those of the Symco soil but have more clay in the subsoil and substratum. Pella soils are lower and are poorly drained. Also included are some small areas where the subsoil and substratum are silty clay or clay. Included areas make up 5 to 10 percent of this unit.

Water and air move through this Symco soil at a moderately slow rate. Surface runoff is slow. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or high. Roots of many crops are restricted by a seasonal high water table at a depth of 1 to 3 feet.

Most areas are farmed. The potential is good for cultivated crops, hay, pasture, and trees. It is poor for most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. Where drainage is provided, crop production is more dependable. Surface and tile drainage are effective in removing excess water. Diversions and grassed waterways are used to control runoff from adjacent slopes.

This soil is suited to pasture and hay. Drainage broadens the range of forage plants that can be grown. Fertilization, renovation, controlled grazing, and restricted use during wet periods can help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table, flooding, and moderately slow permeability. These problems can perhaps be overcome by building a filtering mound of suitable material and installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with and without basements because of the seasonal high water table and flooding. These problems can perhaps be overcome by lowering the seasonal water table by placing tile drains around the foundation footings and using gravity or sump outlets.

This soil is in capability unit IIw-2 and woodland suitability subclass 1o.

**Uf—Udifluvents.** These moderately well drained and somewhat poorly drained, nearly level alluvial soils are on flood plains and in depressions. Some areas are dissected by old stream channels and oxbows. These soils are subject to frequent flooding for brief periods. On flood plains they are typically elongated in shape and range from 3 to 50 acres in size. In depressions they are round and range from 2 to 5 acres in size.

Typically, these soils have a wide range of color and texture. The surface layer is commonly silt loam. The substratum is stratified with sandy, loamy, or silty layers with thin organic layers in some areas. In some places the surface layer is loam, sandy loam, loamy sand, or sand.

Included with these soils in mapping are small areas of Fabius soils, Fluvaquents, and Mussey soils. The somewhat poorly drained Fabius and poorly drained Mussey soils are in similar landscape positions, but have little or no alluvial deposition. The poorly drained and very poorly drained Fluvaquents are lower. Included soils make up about 15 percent of the unit.

The movement of water and air through these Udifluvents, as well as the available water capacity, natural fertility, and organic matter content of the surface layer, are too variable to rate. Surface runoff is slow. These soils have a seasonal high water table at a depth of 1 to 5 feet, unless drained. Roots of most crops are limited by the water table.

Most areas are used for woodland, wildlife habitat, or unimproved pasture. The potential is fair for cultivated crops, hay, pasture, and trees. It is poor for most engineering uses.

These soils are only moderately suited to cultivated crops because of the seasonal high water table and frequent flooding. Where these soils are protected from flooding by dikes, both deep ditch and tile drainage are effective in removing excess water. Where tile drainage is used, a filter should be used to prevent entry of silt and sand into the tile lines. Ditchbanks are susceptible to caving in. When this occurs the ditch is filled with soil material.

If drained and protected from flooding, these soils are moderately suited to hay and pasture. Overgrazing reduces plant cover and encourages undesirable plant species. Loss of plant cover also can result in erosion during periods of stream overflow. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and the plant cover in good condition.

These soils are suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

These soils are poorly suited to septic tank absorption fields and dwellings with and without basements because of the seasonal high water table and flooding. These hazards are difficult to overcome and a more favorable building site should be selected.

These soils are in capability unit IIIw-12. They are not assigned to a woodland suitability subclass.

**UoB—Udorthents, 0 to 6 percent slopes.** These nearly level and gently sloping soils are primarily in or near cities and villages where the soils have been altered by excavating, filling, or leveling. Individual areas are irregular in shape and range from 3 to more than a hundred acres in size.

Typically, these soils have a wide range of color and texture. They are commonly loam, but range to clay or sand and gravel.

Included with these soils in mapping are streets, roads, parking lots, buildings, and fill areas. Also included are some small areas of Casco, Hortonville, Kewaunee, and Onaway soils that have not been altered. Included areas make up about 15 percent of the unit.

The movement of water and air through these Udorthents, as well as the available water capacity, natural fertility, organic matter content of the surface layer, surface runoff, and depth to the seasonal high water table, are too variable to rate.

Most areas are used for urban development. Because of the variable soil characteristics and present land use, the potential is poor for crops and trees. The potential for engineering uses can be determined only by onsite investigation.

The present uses of these soils make it difficult to rate their suitability for cultivated crops, pasture, and trees. Some small portions of these soils are used for gardens, lawns, and ornamental trees and shrubs.

The suitability of these soils for septic tank absorption fields and dwellings with and without basements can be determined only by onsite investigation.

These soils are not assigned to a capability unit or woodland suitability subclass.

**UoF—Udorthents, 25 to 50 percent slopes.** These steep and very steep soils are on lake bluffs and on side slopes of streams and major drainageways. Springs and seep areas are common. Individual areas are long and narrow and range from 5 to 80 acres in size.

Typically, these soils have very little, if any, horizon development. The upper part of the slope is mostly loam or clay loam; the lower part of the slope is stratified fine sand, silt, and clay sediment of variable thickness. In some places the entire soil is loam or clay loam. In some places there are strata of sand and gravel.

Included with these soils in mapping are narrow strips of vegetated beach deposits. Some small areas of Hortonville, Hortonville-Boyer-Zurich complex, and Onaway soils are also included. These soils have typical horizon development. Included areas make up about 15 percent of the unit.

The movement of water and air through these Udorthents, as well as the available water capacity, natural fertility, organic matter content of the surface layer, and depth to the seasonal high water table, are too variable to rate. Surface runoff is very rapid.

These soils are in woodland or wildlife habitat. Many eroded areas are devoid of vegetation. The potential is poor for cultivated crops, hay, pasture, trees, and most engineering uses.

These soils are generally unsuited to cultivated crops and pasture. They are poorly suited to trees.

Natural erosion is a critical hazard on these soils. During periods of subsurface saturation, large blocks of soil break away from lake bluffs and slide to the beach. This erosion is accelerated by wave action during storms, especially in seasons of high lake levels. The risk of slides endangers structures of any kind located near lake bluffs. Erosion can be partially controlled by the use of tile drainage to intercept subsurface seepage. In some areas water control structures can help stabilize gullies. Before any construction of this type is attempted, reliable engineering assistance should be engaged. All applicable local, state, and federal regulations should also be reviewed.

Because of the slope, these soils are not suited to septic tank absorption fields and dwellings with or without basements.

These soils are not assigned to a capability unit or woodland suitability subclass.

**WaA—Wainola loamy fine sand, 0 to 3 percent slopes.** This nearly level and gently sloping, somewhat poorly drained soil is in depressions on lake plains, outwash plains, and lake beaches. Individual areas are irregular in shape and range from 3 to 80 acres in size.

Typically, the surface layer is about 13 inches thick. It is very dark grayish brown and dark grayish brown loamy fine sand in the upper part and light gray fine sand in the lower part. The subsoil is about 16 inches thick. It is dark yellowish brown, mottled, very friable fine sand in the upper part and yellowish brown, mottled, loose fine sand in the lower part. The substratum, to a depth of about 60 inches, is grayish brown, loose fine sand.

Included with this soil in mapping are small areas of Oakville and Roscommon soils. Oakville soils are well drained and are higher on the landscape. Roscommon soils are poorly drained and occupy depressions. Also included are some areas of Wainola soil with stratified sand and gravel substratum at a depth of less than 40 inches. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Wainola soil at a rapid rate. Surface runoff is slow. Available water capacity is low. Natural fertility is low. Organic matter content of the surface layer is moderate. The roots of most crops are restricted by the seasonal high water table at a depth of 1 to 2 feet. In some areas rooting depth may be limited by a strongly cemented layer.

Many areas are farmed. The potential is fair for cultivated crops, hay, and pasture and good for trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. Surface drainage and deep ditches are effective in removing excess water. There is a hazard of sand filling the bottom of drainage ditches. If possible, ditchbanks should be stabilized with vegetation to overcome this problem. Tile drainage is not generally recommended because of the tendency of sand to plug the tile. This problem can be overcome by using a suitable filter. Diversions and grassed waterways are used to control runoff from adjacent slopes.

In dry years when the seasonal high water table is low, crop yields are limited by the low available water capacity. Soil blowing can also be a problem. Windstrips, windbreaks, conservation tillage, and crop rotation can help to decrease soil blowing. Returning crop residues and applying manure help to decrease soil blowing and improve fertility.

This soil is moderately suited to pasture and hay if drained. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table. This problem can perhaps be overcome by building a filtering mound of suitable material and by installing tile drains outside the field to lower the seasonal water table and intercept subsurface seepage from surrounding slopes. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table. This problem can perhaps be overcome by lowering the seasonal water table with tile drains placed around the foundation footings and using gravity or sump outlets.

This soil is in capability unit IVw-5 and woodland suitability subclass 1o.

**We—Wauseon fine sandy loam.** This nearly level, very poorly drained soil is on plane slopes in depressions on lake plains and till plains. Individual areas are irregular in shape and range from 3 to 100 acres in size.

In most places, this soil is covered by a black muck layer about 3 inches thick. Beneath this, the surface layer typically is black, fine sandy loam about 12 inches thick. The subsoil is gray, mottled, friable fine sandy loam about 13 inches thick. The substratum, to a depth of about 60 inches, is dark grayish brown, mottled, firm clay in the upper part and reddish brown, firm clay in the lower part. In some places the surface layer is very fine sandy loam.

Included with this soil in mapping are small areas of Allendale, Markey, Poygan, and Roscommon soils. Allendale soils are higher on the landscape and are somewhat poorly drained. Markey soils have 16 to 51 inches of muck over fine sand. Poygan soils have a clayey subsoil. Roscommon soils are sandy throughout. Markey, Poygan, and Roscommon soils occupy landscape positions similar to Wauseon soil. Included areas make up 5 to 15 percent of the unit.

Water and air move through the subsoil of this Wauseon soil at a rapid rate and through the substratum at a very slow rate. Surface runoff is ponded. Available water capacity is moderate. Natural fertility is medium. Organic matter content of the surface layer is high. Roots are restricted by a seasonal high water table within 6 inches of the surface.

Some areas are farmed; others are in wetland vegetation. The potential is fair for cultivated crops, hay, pasture, and trees. It is poor for most engineering uses. It is good for wetland wildlife habitat.

Where drainage is provided, this soil is moderately suited to corn, small grain, and other cultivated crops. Surface and tile drainage are effective in removing excess water. Tile drains should be covered with a suitable filter to prevent the tile from becoming clogged with sand.

If drained, this soil is moderately suited to pasture and hay. Fertilization, renovation, controlled grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

This soil is suited to woodland. Wetness generally makes it necessary to plant by hand or machine on prepared ridges if natural regeneration is unreliable. Large, vigorous nursery stock is essential. Harvest is frequently limited to when the soil is frozen. Harvest by clear-cut or area-selection methods will reduce windthrow of the remaining trees. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and very slow permeability. This soil is poorly suited to dwellings with or without basements because of the seasonal high water table and high shrink-swell potential.

This soil is in capability unit IIIw-5 undrained. It is in woodland suitability subclass 3w.

**WoB—Waymor silt loam, 1 to 6 percent slopes.** This nearly level and gently sloping, well drained soil is on plane and convex slopes of hills and ridges on till plains. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 8 inches thick. The subsoil is about 23 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam. In some places the surface layer and subsurface layers are sandy loam.

Included with this soil in mapping are small areas of Casco, Dresden, Hortonville, Lamartine, Pella, and Zurich

soils. The Dresden and Casco soils occupy similar landscape positions and have sand and gravel substratums. Hortonville soils have more clay in the lower part of the subsoil and in the substratum and are redder. Lamartine and Pella soils occupy depressions and drainageways. Lamartine soils are somewhat poorly drained. Pella soils are poorly drained. Zurich soils have stratified silt and very fine sand in the substratum. Also included are small areas of sloping Waymor soils.

Water and air move through this Waymor soil at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is good for cultivated crops, pasture, hay, trees, and most engineering uses.

This soil is suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, conservation tillage, contour farming, and grassed waterways help prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve fertility, reduce crusting, increase water infiltration, and decrease erosion.

This soil is suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is suited to septic tank absorption fields. It is only moderately suited to dwellings with or without basements because of the moderate shrink-swell potential of the subsoil. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIe-1 and woodland suitability subclass 2o.

**WoC2—Waymor silt loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on convex slopes of broad ridges on till plains and moraines. Individual areas are elongated in shape and range from 3 to 40 acres in size.

Typically, the surface layer is very dark gray and dark brown silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 6 inches thick. The subsoil is about 21 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam. In some places, the surface layer and subsurface layers are sandy loam.

Included with this soil in mapping are small areas of Casco, Dresden, Hortonville, and Zurich soils that occupy similar landscape positions. Casco and Dresden soils have sand and gravel substratums. Hortonville soils have more clay in the lower part of the subsoil and substratum and are redder. Zurich soils have stratified silt and very fine sand in the substratum. Some small areas of Lamartine soils are also included. These soils are somewhat poorly drained and are in drainageways and depressions. Also included are small areas of moderately steep Waymor soils.

Water and air move through this Waymor soil at a moderate rate. Surface runoff from cultivated areas is medium. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate.

Most areas are farmed. The potential is fair for cultivated crops, pasture, and hay. It is good for trees and most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate hazard of erosion. Crop rotation, conservation tillage, contour farming, and grassed waterways help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping and diversions. Returning crop residues and applying manure help to improve fertility, reduce crusting, decrease erosion, and increase water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. Slope is a limitation that can perhaps be overcome by land leveling or shaping. This soil is moderately suited to dwellings with or without basements. The moderate shrink-swell potential of the subsoil is a limitation that can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab. Slope is a limitation for dwellings. It can perhaps be overcome by land leveling or shaping.

This soil is in capability unit IIIe-1 and woodland suitability subclass 2o.

**WoD2—Waymor silt loam, 12 to 20 percent slopes, eroded.** This moderately steep, well drained soil is on

convex side slopes of hills and ridges on till plains and moraines. Individual areas are elongated in shape and range from 3 to 30 acres in size.

Typically, the surface layer is very dark gray and dark brown silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 4 inches thick. The subsoil is about 20 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Included with this soil in mapping are small areas of Casco, Dresden, Hortonville, and Zurich soils that occupy similar landscape positions. Casco and Dresden soils have sand and gravel substratums. Hortonville soils are redder and have more clay in the lower part of the subsoil and in the substratum. Zurich soils have a stratified silt and very fine sand substratum.

Water and air move through this Waymor soil at a moderate rate. Surface runoff is rapid. Available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate.

Some areas are farmed. The potential is fair for cultivated crops, pasture, and hay. It is good for trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a severe hazard of erosion. Intensive management and soil conservation measures will be needed if this soil is to be cultivated. Contour farming, crop rotations, conservation tillage, stripcropping, diversions, and terracing will help to control excessive soil loss. Many areas of this soil are so small that stripcropping, diversions, and terracing are not practical.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. Soil-related problems of forest management are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest will minimize erosion. Seedling survival on steeper slopes facing south or west can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

Because of the slope, this soil is poorly suited to septic tank absorption fields and dwellings with and without basements. This problem can perhaps be overcome by land leveling or shaping. For dwellings there is also a problem of moderate shrink-swell potential of the subsoil. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IVe-1 and woodland suitability subclass 2r.

**WzB—Waymor-Casco-Zurich complex, 1 to 6 percent slopes.** These nearly level and gently sloping, well drained soils are on plane and convex slopes of knolls and hills on till plains and moraines. Individual areas of this unit are irregular in shape and range from 5 to 70 acres in size. Waymor soil makes up 40 to 60 percent of the unit. Casco and Zurich soils each make up about 20 to 30 percent. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Waymor soil is very dark gray silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 8 inches thick. The subsoil is about 23 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 7 inches thick. The subsoil is dark reddish brown, friable loam about 12 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places the surface layer is loam.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 7 inches thick. The subsoil is about 20 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is stratified light brown, friable silt, very fine sand and fine sand.

Included with these soils in mapping are small areas of Dresden, Hortonville, Kibbie, Lamartine, and Nichols soils. Dresden, Hortonville, and Nichols soils are on similar landscape positions. Kibbie and Lamartine soils occupy depressions and drainageways. Dresden soils have loamy subsoil material to a depth of 20 to 40 inches over sand and gravel. Hortonville soils have more clay in the lower part of the subsoil and in the substratum and are redder than Waymor soil. Lamartine soils are similar to the Waymor soil but are somewhat poorly drained. Kibbie soils are similar to the Zurich soil but are somewhat poorly drained. Nichols soils are similar to the Zurich soil but have less clay in the subsoil. Included are areas where the substratum material of Waymor, Casco, and Zurich soils is so mixed that it is difficult to identify the soil series. Also included are some small sloping areas of this complex and areas where there is a perched seasonal water table at a depth of 3 to 5 feet. Included areas make up 10 to 20 percent of the unit.

Water and air move through the Waymor and Zurich soils at a moderate rate, through the subsoil of the Casco soil at a moderate rate, and through the substra-

tum of the Casco soil at a very rapid rate. Surface runoff from cultivated areas is slow or medium. Available water capacity of the Waymor and Zurich soils is high and of the Casco soil is low. Natural fertility of these soils is medium. Organic matter content of the surface layer is moderately low or moderate. Roots of most crops are limited in Casco soil by the droughty sand and gravel substratum at a depth of 10 to 24 inches.

Most areas are farmed. The potential is good to fair for cultivated crops, pasture, hay, trees (fig. 13) and most engineering uses.

These soils are suited to corn, small grain, and other cultivated crops. If these soils are cultivated, there is a moderate erosion hazard. The Casco soil is also susceptible to soil blowing. Crop rotation, conservation tillage, contour farming, and grassed waterways help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure help to improve fertility, reduce crusting, and increase water infiltration. Small areas of wet soils in this map unit need drainage and grassed waterways to remove excess water. Care should be taken when installing tile in the areas of Zurich soil to prevent silt and sand from filling the tile.

*Figure 13.*—Northern red oak on Waymor soil. This soil is also suited to native sugar maple, basswood, and white ash.

These soils are suited to pasture and hay, and their use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the soil and plant cover in good condition.

The Waymor and Zurich soils are suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

The Casco soil is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

The Waymor and Casco soils are suited to septic tank absorption fields, but there is a danger of ground water contamination by effluent on Casco soil. The Zurich soil is moderately suited to septic tank absorption fields. The moderate permeability is a problem that can perhaps be overcome by enlarging the absorption field. Casco soil is suited to dwellings with and without basements. Waymor and Zurich soils are moderately suited to dwellings with and without basements. The moderate shrink-swell of the subsoil is a problem that can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This complex is in capability unit IIe-1. The Waymor soil is in woodland suitability subclass 2o, the Casco soil is in 3s, and the Zurich soil is in 2o.

**WzC2—Waymor-Casco-Zurich complex, 6 to 12 percent slopes, eroded.** These sloping, well drained soils are on convex slopes of broad ridges on till plains and moraines. Individual areas of this unit are irregular in shape and range from 3 to 40 acres in size. Waymor soil makes up about 40 to 60 percent of the map unit. Casco and Zurich soils each make up about 20 to 30 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Waymor soil is very dark gray and dark brown silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 6 inches thick. The subsoil is about 21 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam

and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 7 inches thick. The subsoil is dark reddish brown, friable loam about 11 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel. In some places the surface layer is loam.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, friable, stratified silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Dresden, Hortonville, Kibbie, Lamartine, and Nichols soils. Dresden, Hortonville, and Nichols soils occupy similar landscape positions. Kibbie and Lamartine soils occupy depressions and drainageways. Dresden soils have loamy subsoil material to a depth of 20 to 40 inches over sand and gravel. Hortonville soils have more clay in the lower part of the subsoil and in the substratum and are redder than Waymor soil. Lamartine soils are similar to the Waymor soil but are somewhat poorly drained. Kibbie soils are similar to the Zurich soil but are somewhat poorly drained. Nichols soils are similar to Zurich soil but have less clay in the subsoil. Also included are areas where the substratum material of Waymor, Casco, and Zurich soils is so mixed that it is difficult to identify the soil series. Some moderately steep areas of this complex are also included. Included areas make up 10 to 20 percent of the unit.

Water and air move through the Waymor and Zurich soils at a moderate rate, through the subsoil of the Casco soil at a moderate rate, and through the substratum of the Casco soil at a very rapid rate. Surface runoff from cultivated areas is medium. Available water capacity of the Waymor and Zurich soils is high and of the Casco soil is low. Natural fertility of these soils is medium. Organic matter content of the surface layer is moderate or moderately low. In the Casco soil, roots of most crops are restricted at a depth of 10 to 24 inches by the droughty sand and gravel substratum.

Most areas of these soils are farmed. The potential is fair for cultivated crops, pasture, and hay. It is good to fair for trees and most engineering uses.

These soils are moderately suited to corn, small grain, and other cultivated crops. If these soils are cultivated, there is a moderate erosion hazard. The Casco soil is also susceptible to soil blowing.

Crop rotation, conservation tillage, contour farming, and grassed waterways help to prevent excessive soil loss. Some areas have slopes that are long and smooth enough for contour stripcropping. Returning crop residues and applying manure help to improve fertility, reduce crusting, and increase water infiltration. Small areas of wet soils in this unit need drainage and grassed waterways to remove excess water. Care should be taken when installing tile in Zurich soil to prevent silt and sand from filling the tile.

These soils are moderately suited to pasture and hay, and their use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the plant cover and soil in good condition.

The Waymor and Zurich soils are suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

The Casco soil of the complex is suited to woodland. Seedling survival can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

These soils are moderately suited to septic tank absorption fields. They are limited by the slope. Zurich soil is also limited by moderate permeability. The slope can perhaps be overcome by land leveling or shaping. The moderate permeability problem on Zurich soil can perhaps be overcome by enlarging the absorption field. There is a danger of ground water contamination by septic tank effluent on Casco soil. These soils are moderately suited to dwellings with and without basements. Slope is a problem, but it can perhaps be overcome by land leveling or shaping. Waymor and Zurich soils are also limited by the moderate shrink-swell potential. This problem can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This complex is in capability unit IIIe-1. The Waymor soil is in woodland suitability subclass 2o, the Casco soil is in 3s, and the Zurich soil is in 2o.

**WzD—Waymor-Casco-Zurich complex, 12 to 20 percent slopes.** These moderately steep soils are on convex side slopes of hills and ridges on till plains and moraines. Individual areas of this unit are elongated in shape and range from 5 to 40 acres in size. Waymor soil makes up about 40 to 60 percent of the unit. Casco and Zurich soils each make up about 20 to 30 percent of the unit. Areas of these soils are so intricately mixed and so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Waymor soil is very dark gray and dark brown silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 4 inches thick. The subsoil is about 20 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 5 inches thick. The subsoil is dark reddish brown, friable loam about 9 inches thick. The substratum, to a depth of 60 inches, is brown, loose sand and gravel. In some places the surface layer is loam.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 5 inches thick. The subsoil is about 18 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, friable, stratified silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Dresden, Hortonville, and Nichols soils that occupy similar landscape positions. Dresden soils have loamy subsoil material to a depth of 20 to 40 inches over sand and gravel. Hortonville soils have more clay in the lower part of the subsoil and in the substratum and are redder than Waymor soil. Nichols soils are similar to Zurich soil but have less clay in the subsoil. Also included are areas where the substratum material of Waymor, Casco, and Zurich soils is so mixed that it is difficult to identify the soil series. Areas of this complex that have slopes greater than 20 percent are also included. Included areas make up 10 to 20 percent of the unit.

Water and air move through the Waymor and Zurich soils at a moderate rate, through the subsoil of the Casco soil at a moderate rate, and through the substratum of the Casco soil at a very rapid rate. Surface runoff from cultivated areas is rapid. Available water capacity of the Waymor and Zurich soils is high and of the Casco soil is low. Natural fertility of these soils is medium. Organic matter content of the surface layer is moderate or moderately low. In the Casco soil, roots are restricted at a depth of 10 to 24 inches by the droughty sand and gravel substratum.

Some areas of this unit are farmed. The potential is poor for cultivated crops, pasture, and hay. It is good to fair for trees. It is fair for most engineering uses.

The Waymor and Zurich soils are moderately suited and Casco soil is generally unsuited to corn, small grain, and other cultivated crops. If these soils are cultivated, there is a severe hazard of erosion. Intensive management and conservation measures will be needed if these soils are to be cultivated. Contour farming, crop rotations, conservation tillage, stripcropping, terraces, and diversions will help to control excessive soil loss. Some areas are so small that stripcropping, terraces, and diversions are not practical.

The Waymor and Zurich soils are moderately suited to pasture and hay. The Casco soil is generally poorly suited to pasture and hay, but its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment of grazing, pasture rotation, and restricted use during wet periods help to keep the plant cover and soil in good condition.

The Waymor and Zurich soils are suited to woodland. Soil-related problems of forest management are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest will minimize erosion. Seedling survival of steeper slopes facing south or west can be increased by careful planting of vigorous planting stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

The Casco soil is suited to woodland. Erosion may be controlled by contour planting of trees and careful location of skid roads during harvest. Survival of planted trees can be increased by careful planting of vigorous nursery stock. Vegetation that competes with natural regeneration following harvest can be controlled by herbicides or mechanical removal.

Because of slope, these soils are poorly suited to septic tank absorption fields and to dwellings with or without basements. This problem can perhaps be overcome by land leveling or shaping.

This complex is in capability unit IVe-1. The Waymor is in woodland suitability subclass 2r, the Casco soil is in 3s, and the Zurich soil is in 2r.

**WzE—Waymor-Casco-Zurich complex, 20 to 35 percent slopes.** These steep and very steep, well drained soils are on convex side slopes of hills and ridges on till plains and moraines. Individual areas of this unit are elongated in shape and range from 3 to 40 acres in size. Waymor soil makes up about 40 to 60 percent of the unit. Casco and Zurich soils each make up about 20 to 30 percent of the unit. Areas of these soils are so small in size and so intricately mixed that it was not practical to separate them in mapping.

Typically, the surface layer of the Waymor soil is very dark gray and dark brown silt loam about 7 inches thick. The subsurface layer is dark brown and brown silt loam about 2 inches thick. The subsoil is about 18 inches thick. It is dark brown and reddish brown, firm silty clay loam in the upper part and reddish brown, firm clay loam and loam in the lower part. The substratum, to a depth of about 60 inches, is brown, friable loam.

Typically, the surface layer of the Casco soil is dark brown sandy loam about 5 inches thick. The subsoil is dark reddish brown, friable loam about 8 inches thick. The substratum, to a depth of about 60 inches, is brown, loose sand and gravel.

Typically, the surface layer of the Zurich soil is dark brown silt loam about 5 inches thick. The subsoil is about 16 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is stratified, light brown, friable silt, very fine sand, and fine sand.

Included with these soils in mapping are small areas of Dresden, Hortonville, and Nichols soils that occupy simi-

lar landscape positions. Dresden soils have loamy subsoil material to a depth of 20 to 40 inches over sand and gravel. Hortonville soils have more clay in the lower part of the subsoil and in the substratum and are redder than Waymor soil. Nichols soils are similar to Zurich soil but have less clay in the subsoil. Also included are areas where the substratum material of Waymor, Casco, and Zurich soils is so mixed that it is difficult to identify the soil series. Areas of this complex where the slope is greater than 35 percent are also included. Included areas make up 10 to 20 percent of the unit.

Water and air move through the Waymor and Zurich soils at a moderate rate, through the subsoil of the Casco soil at a moderate rate, and through the substratum of the Casco soil at a very rapid rate.

Surface runoff from cultivated areas is rapid or very rapid. Available water capacity of the Waymor and Zurich soils is high and of the Casco soil is low. Natural fertility of these soils is medium. Organic matter content of the surface layer is moderate or moderately low. In the Casco soil, roots are restricted at a depth of 10 to 24 inches by the droughty sand and gravel substratum.

The potential is poor for cultivated crops and pasture. It is good to fair for trees. It is poor for most engineering uses.

The soils are suited to woodland. Soil related problems of forest management are associated with steepness of slope or plant competition following harvest. Contour planting of trees and careful location of skid roads during harvest will minimize erosion. Seedling survival on steeper slopes facing south or west can be increased by careful planting of vigorous nursery stock. Competing vegetation that interferes with natural regeneration following harvest can be controlled by herbicides or mechanical removal. Skidding operations may expose sufficient mineral soil to allow adequate regeneration.

These soils are poorly suited to septic tank absorption fields and to dwellings with or without basements because of slope. This problem can perhaps be overcome by land leveling or shaping.

This complex is in capability unit VIe-1. The Waymor soil is in woodland suitability subclass 2r, the Casco soil is in 3s, and the Zurich soil is in 2r.

**ZuA—Zurich silt loam, 0 to 2 percent slopes.** This nearly level, well drained soil in on plane and concave slopes on lake plains. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsoil is about 20 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, friable, stratified silt, very fine sand, and fine sand.

Included with this soil in mapping are small areas of Kibbie, Kibbie Variant, and Nichols soils. Kibbie and Kibbie Variant soils are somewhat poorly drained and occupy drainageways and small depressions. Nichols soils occupy landscape positions similar to the Zurich soil, but have less clay in the subsoil. Also included are some small areas of gently sloping Zurich soils and areas of Zurich soils that are moderately well drained. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Zurich soil at a moderate rate. Surface runoff is slow, and available water capacity is high. Natural fertility is medium, and organic matter content of the surface layer is moderate or moderately low.

Most areas are farmed. The potential is good for cultivated crops, pasture, hay, and trees. It is fair to good for most engineering uses.

This soil is suited to corn, small grain, and cultivated crops. If this soil is cultivated, there is a slight erosion hazard. Returning crop residues and applying manure help to improve fertility, reduce surface crusting, and increase water infiltration.

This soil is suited to pasture and hay. Overgrazing or grazing when the soil is too wet will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. Moderate permeability is a problem, but it can perhaps be overcome by enlarging the absorption field. This soil is moderately suited to dwellings with and without basements. The moderate shrink-swell potential of the subsoil is a problem, but it can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

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

**ZuB—Zurich silt loam, 2 to 6 percent slopes.** This gently sloping, well drained soil is on plane and convex slopes of ridges on lake plains. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is about 20 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is stratified, light brown, friable silt and stratified silt and very fine sand.

Included with this soil in mapping are small areas of Kibbie and Nichols soils. Kibbie soils occupy drainageways and small depressions. They are somewhat poorly drained. Nichols soils are in landscape positions similar to the Zurich soil but have less clay in the subsoil. Also included are some small areas of sloping Zurich soils. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Zurich soil at a moderate rate. Surface runoff from cultivated areas is slow, and available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low.

Most areas are farmed. The potential is good for cultivated crops, pasture, hay, and trees. It is fair for most engineering uses.

This soil is well suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, conservation tillage, and contour farming help to prevent excessive soil loss. Returning crop residues and applying manure help to improve fertility, reduce surface crusting, and increase water infiltration.

This soil is suited to pasture and hay. Overgrazing or grazing when the soil is too wet will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture renovation, timely deferment of grazing and restricted use during wet periods help keep this soil and plant cover in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. Moderate permeability is a problem, but it can perhaps be overcome by enlarging the absorption field. This soil is moderately suited to dwellings with and without basements. The moderate shrink-swell potential of the subsoil is a problem, but it can perhaps be overcome by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIe-1 and woodland suitability subclass 2o.

**ZuC2—Zurich silt loam, 6 to 12 percent slopes, eroded.** This sloping, well drained soil is on convex slopes of broad ridges on lake plains. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. It is brown, friable silty clay loam in the upper part and brown, friable silt loam in the lower part. The substratum, to a depth of about 60 inches, is light brown, friable, stratified silt, very fine sand, and fine sand.

Included with this soil in mapping are small areas of Nichols soils. Nichols soils occupy similar landscape positions, but have less clay in the subsoil. Included areas make up 5 to 15 percent of the unit.

Water and air move through this Zurich soil at a moderate rate. Surface runoff from cultivated areas is medium, and available water capacity is high. Natural fertility is medium. Organic matter content of the surface layer is moderate or moderately low.

Most areas are farmed. The potential is fair for cultivated crops, pasture, and hay and good for trees. It is fair for most engineering uses.

This soil is moderately suited to corn, small grain, and other cultivated crops. If this soil is cultivated, there is a moderate erosion hazard. Crop rotation, contour farming, and grassed waterways help prevent excessive soil loss. Contour stripcropping and diversions are also effective in reducing erosion on long, smooth slopes. Returning crop residues and applying manure help to improve soil fertility, tilth, and increase water infiltration.

This soil is moderately suited to pasture and hay, and its use as pasture and hayland reduces erosion. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the plant cover and soil in good condition.

This soil is suited to woodland. The only soil-related forest management problem is competing vegetation that interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or mechanical removal.

This soil is moderately suited to septic tank absorption fields. The slope and moderate permeability are problems, but they can perhaps be overcome by land leveling or shaping and increasing the size of the absorption field. This soil is moderately suited to dwellings with or without basements. The slope and the moderate shrink-swell potential of the subsoil are problems, but can perhaps be overcome by land leveling or shaping and by placing a layer of coarse material, such as sand and gravel, under the footings and concrete slab.

This soil is in capability unit IIIe-1 and woodland suitability subclass 2o.

## Use and management of the soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each

soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

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

## Crops and pasture

David L. Gruber, district conservationist, Soil Conservation Service, helped prepare this section.

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

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

During 1976 in Kewaunee County 6,500 acres was in corn for grain, 22,000 acres in corn silage, 50,000 acres in alfalfa hay, 14,000 acres in other hay, 34,000 acres in oats, and 5,300 acres in other crops. The rest of the cropland was idle (*11*).

The potential of the soil in Kewaunee County is good for increased production of food. About 128,000 acres in the county is potential prime farmland. This includes 44,700 acres of wet soils that would be prime farmland if it were drained. Another 41,000 acres in the county, some of which is in pasture and woodland, is farmland of statewide importance. Food production could be increased considerably by more extensive use of the latest crop production technology.

Acreage in crops and pasture has been gradually decreasing as more and more land is used for urban development. In 1977 there was an estimated 8,000 acres of urban and built-up land in the county; this figure has been increasing at the rate of about 150 acres per year.

*Erosion* is the major soil problem on about two-thirds of the cropland and pasture in Kewaunee County. Where the slope is steeper than 2 percent, erosion is generally a hazard on soils, such as those of the Casco, Dresden, Hortonville, Kewaunee, Kolberg, Longrie, Onaway, Waymor, and Zurich series.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plowed layer. This is especially damaging on soils with a moderately fine or fine textured subsoil, such as the Hortonville, Kewaunee, and Kolberg soils. Eroded areas of these soils form clods if tilled when wet and crust after heavy rain. Erosion is also damaging on soils that have a layer that limits the depth of the root zone in or below the subsoil. Such a layer could be sand and gravel, as in Casco soils, or bedrock, as in Kolberg Variant, Longrie, and Namur soils. Erosion also reduces productivity on soils that tend to be droughty, such as Boyer, Menominee Variant, and Oakville soils, because much of the fertility is in the organic matter in the surface layer. Second, soil erosion results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps plant cover on the soil for extended periods can hold soil erosion losses to amounts that will not appreciably reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion and also provide nitrogen and improve tilth.

Slopes are so short and irregular that contour stripcropping or terracing is not practical on many areas of sloping Boyer, Casco, Hortonville, Kewaunee, Kolberg, Omro, and Zurich soils. On these soils, cropping systems that provide substantial plant cover are needed to control erosion unless conservation tillage is practiced. Conservation tillage, use of winter cover crops, and leaving crop residues on the surface help to increase infiltration and reduce runoff and the hazard of erosion. These practices can be adapted to most soils in Kewaunee County, but are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer, such as the severely eroded Kewaunee soils.

Terraces and diversions shorten the slope and reduce runoff and erosion. These constructions are most practical on deep, well drained soils that have long, uniform slopes. Some of the Onaway and Waymor soils are suited to terraces. Many other soils are less suited to terraces and diversions because of irregular slopes, excessive wetness in the terrace channels, a clayey subsoil that would be exposed in terrace channels, or bedrock within a depth of 40 inches. The use of field tile with terraces and diversions will reduce wetness in the channels and help establish and maintain a good seedbed.

Contouring and contour stripcropping are accepted erosion control practices in Kewaunee County. They are

best adapted to soils with smooth uniform slopes, including most areas of the sloping Onaway and Waymor soils and some sloping areas of Hortonville soils. Wet soils in small depressions need tile drainage if alfalfa in the strips is to survive.

Soil blowing is a hazard on the sandy soils and on the organic soils such as Carbondale, Cathro, and Markey soils if they are drained and cultivated. Soil blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining plant cover, surface mulch, or rough surfaces through proper tillage minimizes soil blowing on these soils. Windbreaks of adapted shrubs and trees can also reduce soil blowing.

Information on the design of erosion control practices for each kind of soil is contained in the Technical Guide at local offices of the Soil Conservation Service.

*Drainage* is the major management need on about one-third of the land in Kewaunee County. Some soils are so naturally wet that the production of crops common to the area is generally not possible without drainage. These soils are the poorly drained and very poorly drained Angelica, Bach, Mussey, Pella, Poygan, Roscommon, Ruse, and Wauseon soils. Also needing drainage are the organic soils such as Carbondale, Cathro, and Markey.

Unless artificially drained, the somewhat poorly drained soils are also so wet that crops are damaged during most years. Poorly drained soils include Allendale, Bonduel, Fabius, Kibbie, Lamartine, Manawa, Matherton, Mosel, Shiocton, Solona, Symco, and Wainola soils. Grassed waterways constructed on these soils need tile drainage to reduce wetness and help establish and maintain good plant cover. On slopes steeper than 2 percent, these soils are subject to erosion.

Hortonville, Kewaunee, Kolberg, and Omro soils are well drained, but tend to dry out slowly after heavy rains. These soils may benefit from surface drainage (fig. 14). Small areas of wet soils along drainageways and in swales which have been included with these soils in mapping need tile drainage so the soils dry uniformly.

The design of both surface and subsurface drainage systems depends on the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the poorly drained and very poorly drained soils used for intensive row cropping. Drains have to be more closely spaced in soils that have slow permeability than

*Figure 14.*—Waterway construction on the Symco and Hortonville soils.

in the more permeable soils. Finding adequate outlets for tile drainage systems is difficult in many areas of Bonduel soils. Tile drains should be protected from clogging in soils that have layers of silt, very fine sand, or fine sand in the subsoil or substratum. These soil particles flow when wet and enter the tile. Bach, Kibbie, Kibbie Variant, and Shiocton soils are underlain by silt, very fine sand, or fine sand.

Organic soils, which oxidize and subside if they are drained, need special drainage systems to control the depth of the water table and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimizes the oxidation and subsidence of organic soils. Information on drainage design for each kind of soil is contained in the Technical Guide at local offices of the Soil Conservation Service.

*Fertility* is naturally low or medium in most soils of the uplands in Kewaunee County. Kewaunee, Kibbie Variant, Kolberg, and Omro soils have high natural fertility. The poorly drained Pella and Poygan soils also have high natural fertility. Reaction of most soils in the county ranges from neutral to moderately alkaline.

On all soils additions of fertilizer and lime should be based on soil tests, the need of the crop, and the desired level of yields. The Cooperative Extension Service can help determine the kinds and amounts of fertilizer and lime to apply.

*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.

Most of the soils used for crops in the county have a silt loam surface layer that is light in color and moderate to low in content of organic matter. Generally the structure of such soils is weak, and intense rainfall causes the formation of a crust on the surface. This crust is hard when dry and nearly impervious to water. It reduces the infiltration rate, increases runoff, and hinders the emergence of small seeded crops. Regular additions of crop residues, manure, and other organic material can help to improve soil structure and to reduce crust formation.

Fall plowing is a traditional practice in the county. On light-colored soils with loam or silt loam surface layers, this practice results in crusting during the winter and spring. Fall plowing also subjects the land to damaging erosion. Less tillage in the fall will reduce crusting and erosion on these soils.

Eroded areas of Hortonville, Kewaunee, Kolberg, and Omro soils have a tilth problem because of clay mixed in the plowed layer. These soils often stay wet until late spring. If they are wet when plowed, they tend to be very cloddy when dry. Good seedbeds are difficult to prepare. On these soils, fall plowing generally results in good tilth in spring.

*Field crops* suited to the soils and climate of Kewaunee County include many that are not now commonly grown. These include barley, winter wheat, peas, sweet corn, snap beans, and similar crops.

*Special crops* such as strawberries and vegetables are grown on a very small acreage. Apples and cherries are the most important orchard crops. Apples are grown on gently sloping and sloping Bonduel, Casco, Dresden, Fabius, Hortonville, Lamartine, Longrie, Onaway, Solona, Symco, Waymor, and Zurich soils. Most other soils in the county are poorly suited to commercial apple production.

Cherry trees are grown on the well drained Casco, Dresden, Hortonville, Longrie, Menominee Variant, Onaway, Waymor, and Zurich soils that have slopes of less than 12 percent. The other soils are poorly suited to cherry production.

Even if adequately drained, the organic soils in the county have a frost hazard that restricts the growing of some vegetable crops.

Information and suggestions for growing special 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 4. 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 4 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 (*7*). 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. 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 slight limitations that restrict their use.

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

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

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

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

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

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

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

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

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

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 5. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

## Woodland management and productivity

George W. Alley, forester, U.S. Soil Conservation Service, helped prepare this section.

Kewaunee County was entirely forested before settlement. The county was covered with a northern hardwood forest except for the Black Ash Swamp in the north-central part, which supports a mixed swamp hardwood-conifer forest type (*9*).

Most of the land area of the county has been cleared for agricultural crops. About 14 percent remains in woodland. This woodland was classified by a survey in 1968 into the following forest types: maple-beech-birch, 13,000 acres; elm-ash-cottonwood, 7,300 acres; oak-hickory, 4,300 acres; conifers, 3,600 acres; aspen-birch, 2,600 acres; and nonstocked, 100 acres (*10*).

Because of the limited woodland acreage, the economic importance of woodland is rather small in Kewaunee County. Some saw logs and round wood are harvested as are some cedar posts and poles, partly for farm use.

Table 6 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 6, *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 con-

struction, 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.

Additional information about woodland management and productivity can be obtained from the Wisconsin Department of Natural Resources, the local office of the Soil Conservation Service, or the Cooperative Extension Service.

## 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 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 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, from a nursery, or from the Wisconsin Department of Natural Resources.

## Recreation

The soils of the survey area are rated in table 8 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 8, 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 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

*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

Steve F. Baima, biologist, Soil Conservation Service, helped prepare this section.

Wildlife responds to good land management. Usually the population of adapted wildlife is in balance with the availability of essential habitat elements, including food, cover, and water. Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover. Soils also affect the construction of ponds and other developments that provide water and wetland habitat elements.

The essential habitat elements for wildlife generally depend on several kinds of soil and a combination of land uses. The diversity of wildlife is determined by the diversity of soils, land uses, and management.

In the following paragraphs, the eight map units shown on the General Soil Map are divided into four wildlife areas according to the species that inhabit the units and the potentials for wildlife habitat development. Wetland types in parentheses are those recognized by the U.S. Department of the Interior (*3*).

**Wildlife area 1.** This wildlife area is made up of the Kewaunee-Manawa, Hortonville-Symco, Onaway-Solona-Hortonville, Waymor-Lamartine-Pella, and Kolberg-Namur-Longrie map units. The soils range from well drained to poorly drained; the major soils are well drained.

Seventy-nine percent of the county is in this area. Cropland used for the production of grain and seed crops is the principal habitat element. Major soils are generally fall plowed, leaving little food or cover for wildlife. Scattered farm woodlots, mostly on the steeper slopes and wetland areas of the minor soils, provide important habitat diversity.

Wetlands are not a permanent feature on the better drained soils, but seasonally flooded basins and flats (type 1) are common early in spring. These wetlands are extremely important to migrating waterfowl and shore birds, which use them as resting and feeding areas. During migration, large concentrations of waterfowl gather in these wetlands and pair for the oncoming breeding season.

Fresh meadows and shrub swamps (types 2 and 6) are on some of the poorly drained soils, such as Carbondale and Pella. The diversity of habitat that these minor soils provide is of great importance to wildlife in this intensively farmed part of the county.

Upland wildlife predominate in wildlife area 1. Major game species include pheasant, Hungarian partridge, cottontail rabbit, and limited numbers of gray and fox squirrels and deer. In some areas, waterfowl and shore birds feed extensively on cropland. Numerous nongame species, particularly songbirds, are abundant in woodlots and along the borders of adjoining habitats.

**Wildlife area 2.** The Casco-Boyer map unit is wildlife area 2. Casco and Boyer soils are well drained. They occupy about 35 percent of the wildlife area. Minor soils, which make up 65 percent of the area, range from well drained to poorly drained. The large extent of minor soils provides abundant habitat diversity.

Wildlife area 2 covers about 13 percent of the county. It is on outwash plains and terraces associated with major streams. Grain and seed crops are the principal habitat elements provided by the Casco and Boyer soils. Wetland, grassland, and woodland habitats are provided mostly on the minor soils.

The area is linear and relatively narrow. This shape enables it to provide a good measure of habitat diversity for wildlife in adjacent areas that are more intensively farmed.

Pheasants, Hungarian partridge, and red fox are common on the major soils of wildlife area 2. Woodcock, ruffed grouse, cottontail rabbit, fox and gray squirrel, muskrat, mink, and raccoon are more common on the minor soils.

**Wildlife area 3.** The Carbondale-Cathro-Markey map unit is wildlife area 3. The major soils are nearly level, very poorly drained, organic soils.

This area covers about 7 percent of the county. The major soils, which make up 82 percent of the area, are scattered throughout the county but predominate in several localities. Natural vegetation on these soils is wetland-adapted species, such as sedges, prairie cordgrass, black ash, red maple, white cedar, and tamarack.

Woodland, grassland, and wetland are the principal habitats. Fresh meadows, shrub swamps, and wooded swamps (types 2, 6 and 7) are the most common wetlands. Shallow and deep fresh marshes are scattered throughout the area on more poorly drained sites.

Habitats in wildlife area 3 are extremely important because of their year-round availability. In winter, wildlife from more intensively farmed areas depend on this area for food and cover. White-tailed deer and pheasants, for example, use shrub swamps for winter cover. Ruffed grouse, white-tailed deer, woodcock, cottontail rabbits, gray and fox squirrels, muskrats, mink, and raccoon are common.

**Wildlife area 4.** The Wainola-Oakville map unit is wildlife area 4. The major soils are somewhat poorly drained and well drained. Major soil areas include stabilized sand dunes and extinct glacial lake sandy beach ridges and troughs along Lake Michigan.

This wildlife area covers about 0.2 percent of the county. It is treated as a separate wildlife area because of its unique soils, land forms, and vegetation. Very poorly drained and poorly drained soils, such as Carbondale and Angelica soils, are minor soils that occupy drainageways and depressions.

Wetland plants thrive in the troughs and depressions. Upland woody and herbaceous plants grow on the better drained major soils on ridges. These ridges alternate with the wet troughs and depressions to create an ideal wildlife habitat.

Woodland and wetland wildlife and numerous nongame species, particularly songbirds, use the area.

In table 9, 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, oats, and barley.

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

*Wild herbaceous plants* are native or naturally established dryland 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, beggarweed, indiangrass, 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, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and alder. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

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

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the

surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

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

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

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

## Engineering

Michael L. Tiry, civil 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 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

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

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

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

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

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

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

### Building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. Potential frost action is not considered, but proper design of footings and suitable subbase material are needed on most soils in the county. 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 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, and the available water capacity in the upper 40 inches 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 11 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 11 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 60 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. Where permitted by ordinance, it may be possible to build filtering mounds over wet or impervious soil or soil underlain by bedrock.

*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 11 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 11 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, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 5 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

**Construction materials**

Table 12 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 these materials. 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 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 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 used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantites of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 5 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

*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 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 or stones 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 or stones, 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 13 gives information on the soil properties and site features that affect water management. It gives for each soil the restrictive features that affect pond reservoir areas; embankments, dikes, and levees; drainage; irrigation; terraces and diversions; and grassed waterways.

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

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

The ability of the natural soil to support an embankment is not considered. 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, boulders, or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

*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 alkalinity. 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 and soil reaction.

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

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

# Soil properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

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

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

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

*Classification* of the soils is determined according to the Unified soil classification system (*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. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

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

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

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

## Physical and chemical properties

Table 15 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 soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate,

except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

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

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

In table 15, 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 16 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 runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

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

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

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. Only saturated zones within a depth of about 6 feet are indicated.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Subsidence* is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence

results from either dessication and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 16 shows the expected initial subsidence, which usually is a result of drainage, and annual subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

*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.

### Engineering index test data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and morphology." The soil samples were tested by the Wisconsin Department of Transportation, Division of Highways.

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

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

## Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*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 18, 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 Mollisol.

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 Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

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 Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that have an aquic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the prop-

erties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Typic Haplaquolls.

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

## Soil series and morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*6*). 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 "Soil maps for detailed planning."

### Allendale series

The Allendale series consists of deep, somewhat poorly drained soils on lake plains and till plains. The soils are rapidly permeable in the upper part and slowly permeable in the lower part. They formed in sandy and loamy lacustrine material and in the underlying clayey lacustrine sediment or glacial till. Slope ranges from 0 to 3 percent.

Allendale soils are similar to Wainola soils and are adjacent to Manistee and Wauseon soils. Wainola soils are sandy throughout. Manistee soils are well drained and occupy higher landscape positions. Wauseon soils are very poorly drained and occupy lower areas in the landscape.

Typical pedon of Allendale loamy fine sand, 0 to 3 percent slopes, approximately 700 feet west and 720 feet north of SE corner of section 9, T. 25 N., R. 23 E:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine and medium subangular blocky structure; friable; few roots; neutral; abrupt smooth boundary.

B2ir—9 to 15 inches; dark brown (7.5YR 4/4) fine sand; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; very friable; neutral; clear irregular boundary.

A'2—15 to 22 inches; brown (10YR 5/3) fine sand; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; mildly alkaline; clear irregular boundary.

B'21t—22 to 26 inches; reddish brown (5YR 4/4) sandy loam; many medium prominent yellowish red (5YR 5/8) and many weak distinct reddish gray (5YR 5/2) mottles; weak medium subangular blocky structure; friable; thin patchy clay films; mildly alkaline; clear wavy boundary.

IIB22t—26 to 32 inches; reddish brown (5YR 4/4) silty clay; many fine prominent yellowish red (5YR 5/8) and few fine distinct reddish gray (5YR 5/2) mottles; moderate fine and medium subangular blocky structure; firm; thin patchy clay films; mildly alkaline; clear wavy boundary.

IIC—32 to 60 inches; reddish brown (5YR 5/4) silty clay; few fine distinct pinkish gray (5YR 6/2) mottles; massive; firm; few fine prominent white (10YR 8/1) calcium carbonate nodules; about 5 percent pebbles by volume; strong effervescence; moderately alkaline.

The thickness of the sandy mantle and depth to clayey material range from 20 to 40 inches. The Ap horizon is very dark brown, very dark grayish brown, or dark grayish brown. Where present, the A1 horizon is very dark gray, very dark grayish brown, or black and is 3 to 5 inches thick. The B2ir horizon is fine sand, loamy fine sand, or fine sandy loam. Some pedons have a weakly to strongly cemented ortstein horizon. The A2 horizon is pale brown or brown and in some pedons includes peds of the underlying B21t horizon. The IIB22t horizon and IIC horizon are dominantly silty clay, but they are clay in some pedons. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

### Angelica series

The Angelica series consists of deep, poorly drained, moderately slowly permeable soils in depressions on till plains. The soils formed in thin loess and underlying loamy calcareous till. Slope ranges from 0 to 2 percent.

Angelica soils are similar to Pella soils and are commonly adjacent to Carbondale, Cathro, Solona, and Onaway soils. Carbondale and Cathro soils occupy lower areas in the landscape and formed in organic deposits. Solona soils are higher in the landscape than Angelica soils and are somewhat poorly drained. Pella soils have thicker solum than the Angelica soils. Onaway soils are higher than Angelica soils and are well drained.

Typical pedon of Angelica silt loam, approximately 1,080 feet south and 120 feet west of NE corner of section 3, T. 25 N., R. 25 E:

Ap—0 to 6 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

B2g—6 to 13 inches; grayish brown (10YR 5/2) silt loam, common fine prominent strong brown (7.5YR 5/8) mottles; and common fine black (10YR 2/1) worm casts; weak coarse subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.

B2t—13 to 18 inches; reddish brown (5YR 4/4) loam; common fine distinct grayish brown (10YR 5/2) and common fine prominent reddish yellow (5YR 6/8) mottles; weak medium subangular blocky structure; friable; few thin patchy clay films on faces of peds and in root pores; strong effervescence; mildly alkaline; clear wavy boundary.

B3—18 to 21 inches; reddish brown (5YR 5/4) loam; few fine distinct light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; friable; violent effervescence; mildly alkaline; clear wavy boundary.

C—21 to 60 inches; brown (7.5YR 5/4) loam; few fine distinct light brownish gray (10YR 6/2) and few fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; violent effervescence; mildly alkaline.

The thickness of the solum ranges from 12 to 30 inches. Limestone cobbles and fragments occur throughout the profile in some pedons. The A1 or Ap horizon is black, very dark brown, very dark gray, or very dark grayish brown. The B2g horizon is silt loam, sandy loam, or loam. The chromas are always 1 or 2. The Bt horizon is loam, sandy clay loam, or clay loam. The C horizon is predominantly loam but is gravelly loam, silt loam, or sandy loam in some pedons. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Bach series

The Bach series consists of deep, poorly drained, moderately permeable soils in depressions on lake plains. The soils formed in loamy and sandy, calcareous lacustrine sediment. Slope ranges from 0 to 2 percent. In Kewaunee County these soils have a mollic epipedon and a thinner solum than is defined for the series, but these differences do not alter their behavior.

Bach soils are similar to Pella soils and are commonly adjacent to Kibbie and Shiocton soils. Pella soils are similar in drainage characteristics but formed in silt loam and loamy glacial till. Kibbie and Shiocton soils are higher in the landscape and are somewhat poorly drained. Kibbie also has more clay in the subsoil than Bach soils.

Typical pedon of Bach silt loam, approximately 1,800 feet east and 1,300 feet south of NW corner of section 33, T. 22 N., R. 23 E:

A11—0 to 5 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; neutral; clear wavy boundary.

A12—5 to 10 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; mildly alkaline; abrupt wavy boundary.

B2g—10 to 14 inches; dark gray (5Y 4/1) very fine sandy loam; weak medium and thick platy structure parting to weak fine and very fine subangular blocky; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1g—14 to 24 inches; stratified light gray (2.5Y 7/2) silt and grayish brown (10YR 5/2) very fine sand; few fine prominent brownish yellow (10YR 6/6) mottles; weak medium and thick platy structure; very friable; slight effervescence; moderately alkaline; clear smooth boundary.

C2g—24 to 45 inches; light brownish gray (2.5Y 6/2) stratified silt and very fine sand; few fine distinct light yellowish brown (2.5Y 6/4) mottles; weak medium subangular blocky structure; very friable; slight effervescence; moderately alkaline; clear smooth boundary.

C3g—45 to 49 inches; grayish brown (2.5Y 5/2) very fine sand; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; very friable; slight effervescence; moderately alkaline; clear smooth boundary.

C4—49 to 60 inches; grayish brown (2.5Y 5/2) silt; common medium prominent yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; massive; friable; slight effervescence; mildly alkaline.

The thickness of solum ranges from 12 to 24 inches. Depth to carbonates generally corresponds to thickness of solum. The B2g horizon is silt loam, very fine sandy loam, or fine sandy loam. The C horizon below a depth of 36 inches is light gray, light brownish gray, grayish brown, or dark grayish brown. The C horizon is typically stratified silt, very fine sand, or fine sand, but in some pedons there are thin layers of silty clay loam. The subsoil is neutral to moderately alkaline; the substratum is mildly alkaline or moderately alkaline.

## Bonduel series

The Bonduel series consists of moderately deep, somewhat poorly drained, moderately permeable soils on bedrock-controlled till plains. The soils formed in loamy glacial till. Slope ranges from 0 to 2 percent.

Bonduel soils are adjacent to Kolberg, Longrie, Namur, and Solona soils. Kolberg, Longrie, and Namur soils are well drained and occupy higher landscape positions. Namur soils have dolomite at a depth of 5 to 12 inches. Solona soils are underlain by till and have no dolomite.

Typical pedon of Bonduel loam, approximately 2,200 feet west and 960 feet north of SE corner of section 16, T. 24 N., R. 23 E:

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; neutral; abrupt smooth boundary.
A2—6 to 7 inches; grayish brown (10YR 5/2) loam; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.
B1—7 to 13 inches; dark yellowish brown (10YR 4/4) loam; weak very fine and fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.
B2t—13 to 20 inches; reddish brown (5YR 5/3) loam; few fine faint pinkish gray (5YR 6/2) and few fine prominent yellowish red (5YR 5/8) mottles; weak very fine and fine subangular blocky structure; friable; thin patchy clay films; mildly alkaline; clear wavy boundary.
B3—20 to 25 inches; reddish brown (5YR 5/3) fine sandy loam; few fine faint pinkish gray (5YR 6/2) and common fine prominent yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; friable; mildly alkaline; clear wavy boundary.
C—25 to 30 inches; light brown (7.5YR 6/4) sandy loam; few fine distinct pinkish gray (5YR 6/2) and few fine prominent yellowish red (5YR 5/8) mottles; massive; friable; slight effervescence; mildly alkaline; abrupt smooth boundary.
R—30 to 60 inches; dolomite bedrock.

The thickness of the solum and the depth to dolomite range from 20 to 40 inches. The Ap horizon is very dark grayish brown or very dark brown. Many cultivated pedons have no A2 horizon. Some pedons have A&B or B&A horizons. Some pedons also have a B1 horizon. The B2t horizon is loam, silt loam, or clay loam. Mottles are present in the upper part of the B2t horizon. Clay films range from few to many and patchy to continuous. Some pedons have no B3 horizon or no C horizon; some have neither. Some pedons have a layer of clayey residuum up to 4 inches thick directly above the bedrock. It weathered from dolomite. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Boyer series

The Boyer series consists of deep, well drained soils on outwash plains. The soils are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They formed in sandy and loamy outwash. Slope ranges from 1 to 35 percent. In Kewaunee County, these soils have a thicker loamy sand upper solum and are more alkaline than is defined for the series, but these differences do not alter their behavior.

Boyer soils are commonly adjacent to Casco, Fabius, and Oakville soils. Casco soils are in similar landscape positions but have a thinner solum and contain more clay in the subsoil. Fabius soils occupy drainageways and depressions and are somewhat poorly drained. Oakville soils are sandy throughout.

Typical pedon of Boyer loamy sand, 1 to 6 percent slopes, approximately 1,980 feet west and 40 feet north of SE corner of section 36, T. 22 N., R. 23 E:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; few roots; about 3 percent pebbles by volume; mildly alkaline; abrupt smooth boundary.
A2—10 to 14 inches; yellowish brown (10YR 5/4) loamy sand; few fine distinct very dark grayish brown (10YR 3/2) worm casts; weak fine subangular blocky structure; very friable; about 3 percent pebbles by volume; mildly alkaline; clear wavy boundary.
A3—14 to 26 inches; dark yellowish brown (10YR 4/4) loamy sand; single grain; loose; about 3 percent pebbles by volume; mildly alkaline; abrupt wavy boundary.
B2t—26 to 35 inches; reddish brown (5YR 4/4) sandy loam; weak fine and medium subangular blocky structure; friable; some clay bridging of sand grains; about 5 percent pebbles by volume; mildly alkaline; abrupt wavy boundary.
B3—35 to 36 inches; yellowish brown (10YR 5/6) loamy sand; weak fine subangular blocky structure, very friable; about 5 percent pebbles by volume; mildly alkaline; clear wavy boundary.
C—36 to 52 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slight effervescence; mildly alkaline; clear wavy boundary.
C2—52 to 60 inches; yellowish brown (10YR 5/4) sand and gravel; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum and depth to underlying sand and gravel range from 22 to 40 inches. The A1 horizon ranges from 1 to 5 inches in thickness. It is dark grayish brown, grayish brown, brown, or very dark grayish brown. The A2 horizon is brown, pale brown, yellowish brown, or light yellowish brown. It is loamy sand or sand. Some pedons do not have an A2 horizon. The Bt horizon is sandy loam, fine sandy loam, or gravelly sandy loam or there are thin subhorizons of sandy clay loam. In some areas the Bt horizon consists of 2- to 4-inch layers separated by A2 horizons of loamy sand. Some pedons have a B3 horizon. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Carbondale series

The Carbondale series consists of deep, very poorly drained, moderately rapidly permeable soils in depres-

sions on lake plains and in stream valleys. The soils formed in organic deposits, mainly from herbaceous plants. Slope ranges from 0 to 2 percent.

Carbondale soils are commonly adjacent to Angelica, Cathro, Markey, and Pella soils. Angelica and Pella soils are poorly drained mineral soils that are slightly higher than Carbondale soils. Cathro soils are organic deposits underlain by loamy material at a depth of 16 to 51 inches. Markey soils are organic deposits underlain by sandy soil material at a depth of 16 to 51 inches.

Typical pedon of Carbondale muck, approximately 2,000 feet east and 50 feet south of NW corner of section 33, T. 22 N., R. 23 E:

Oa1—0 to 8 inches; black (N 2/0), broken face and rubbed, sapric material; about 15 percent fiber, 4 percent rubbed; weak medium granular structure; primarily herbaceous fibers; neutral; abrupt wavy boundary.

Oa2—8 to 27 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 25 percent fiber, 8 percent rubbed; weak medium granular structure; primarily herbaceous fibers; neutral; abrupt wavy boundary.

Oe1—27 to 35 inches; black (10YR 2/1), broken face and rubbed, hemic material; about 65 percent fiber, 30 percent rubbed; massive; primarily herbaceous fibers with a few woody fragments; slightly acid; clear wavy boundary.

Oe2—35 to 41 inches; black (10YR 2/1), broken face and rubbed, hemic material; about 75 percent fiber, 30 percent rubbed; massive; primarily herbaceous fibers with a few woody fragments; slightly acid; clear wavy boundary.

Oe3—41 to 60 inches; black (10YR 2/1), broken face and rubbed, hemic material; about 75 percent fibers, 30 percent rubbed; massive; primarily herbaceous fibers; slightly acid.

The thickness of the organic deposits ranges from 51 inches to 60 inches or more. Woody fragments, up to an inch in diameter, make up a minor portion of the recognizable fiber and are mainly in the middle and bottom tiers. The bottom tier is dominated by hemic material, but has thin layers of coprogenous (sedimentary peat) material in some pedons. Reaction commonly is slightly acid or neutral, but is medium acid in a few pedons.

## Casco series

The Casco series consists of deep, well drained soils on outwash plains and glacial moraines. The soils are moderately permeable in the upper part and very rapidly permeable in the lower part. They formed in loamy material overlying sand and gravel outwash. Slope commonly ranges from 0 to 12 percent, but is up to 35 percent in complex with other soils.

Casco soils are similar to Dresden soils and are commonly adjacent to Dresden, Fabius, Matherton, Menominee Variant, Mussey, and Rodman soils. Fabius and Matherton soils are somewhat poorly drained. Dresden soils have loamy material to a depth of 20 to 40 inches over the sand and gravel substratum. Menominee Variant soils have a sandy upper profile with a spodic B horizon. Mussey soils are poorly drained. Rodman soils are thinner over sand and gravel.

Typical pedon of Casco sandy loam, 6 to 12 percent slopes, eroded, approximately 3,000 feet west and 200 feet north of SE corner of section 30, T. 22 N., R. 24 E:

Ap—0 to 7 inches; dark brown (10YR 4/3) sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; common roots; neutral; abrupt smooth boundary.

B2t—7 to 12 inches; dark reddish brown (5YR 3/3) loam; moderate fine and medium subangular blocky structure; friable; few roots; thin patchy clay films; about 8 percent pebbles by volume; mildly alkaline; clear wavy boundary.

B3t—12 to 18 inches; dark reddish brown (5YR 3/4) loam; moderate fine subangular blocky structure; friable; few thin patchy clay films; about 8 percent pebbles by volume; mildly alkaline; abrupt wavy boundary.

IIC—18 to 60 inches; brown (10YR 5/3) sand and white (10YR 8/2) gravel; single grain; loose; violent effervescence; moderately alkaline.

The thickness of the solum and depth to underlying sand and gravel range from 10 to 24 inches. Uncultivated areas have a 1- to 4-inch A1 horizon. The A1 horizon and Ap horizon are brown, dark brown, or dark grayish brown. Some pedons have a brown or dark grayish brown A2 horizon. In some pedons coatings of the A2 horizon material is on faces of peds in the Bt horizon. The Bt horizon is sandy clay loam, loam, or clay loam. Some pedons are up to 25 percent pebbles in the solum. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Cathro series

The Cathro series consists of deep, very poorly drained soils in depressions on outwash plains and till plains and in stream valleys. The soils are moderately rapidly permeable in the upper part and moderately slowly permeable in the lower part. They formed in organic deposits underlain by loamy material. Slope ranges from 0 to 2 percent.

Cathro soils are similar to Markey soils and are commonly adjacent to Angelica, Carbondale, Markey, and Pella soils in the landscape. Angelica and Pella soils are poorly drained mineral soils that are slightly higher than Cathro soils. Carbondale soils formed in organic deposits more than 51 inches deep. The organic horizons of Markey soils are underlain by sandy material at a depth of 16 to 51 inches.

Typical pedon of Cathro muck, approximately 900 feet east and 50 feet south of NW corner of section 22, T. 25 N., R. 23 E:

Oa1—0 to 9 inches; black (10YR 2/1) broken face and rubbed, sapric material; about 10 percent fiber, 2 percent rubbed; weak fine granular structure; primarily herbaceous fibers; neutral; clear wavy boundary.

Oa2—9 to 25 inches; black (10YR 2/1) broken face and rubbed, sapric material; about 40 percent fiber, 8 percent rubbed; weak medium platy structure; primarily herbaceous fibers; neutral; clear wavy boundary.

IIC1g—25 to 32 inches; gray (10YR 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; slight effervescence; mildly alkaline; clear wavy boundary.

IIC2—32 to 54 inches; dark reddish gray (5YR 5/2) loam; few medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; strong effervescensce; mildly alkaline; clear wavy boundary.

IIC3—54 to 60 inches; dark reddish gray (5YR 4/2) silt loam; massive; friable; strong effervescence; mildly alkaline.

The thickness of the organic layers and depth to loamy material range from 16 to 51 inches. The organic layers are primarily sapric material derived from herbaceous plants. In some pedons there are thin layers of hemic material derived from herbaceous or woody plants, but these layers have a combined thickness of less than 10 inches. The IIC horizons typically are loam, but range to sandy loam, silt loam, clay loam, or silty clay loam. The organic layers are commonly neutral, but range from medium acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

## Dresden series

The Dresden series consists of deep, well drained soils on outwash plains. The soils are moderately permeable in the upper part and very rapidly permeable in the lower part. They formed in loamy material over sand and gravel. Slope ranges from 0 to 6 percent. In Kewaunee County, these soils are redder in the lower B horizon than is defined for the series, but this does not alter their behavior.

Dresden soils are similar to Casco soils and are commonly adjacent to Casco, Matherton, and Mussey soils. Casco soils are in similar landscape positions but are underlain by sand and gravel at a depth of 10 to 24 inches. Matherton soils occupy depressions and drainageways and are somewhat poorly drained. Mussey soils occupy depressions and drainageways and are poorly drained.

Typical pedon of Dresden silt loam, 2 to 6 percent slopes, approximately 2,590 feet east and 880 feet north of SW corner of section 31, T. 23 N., R. 24 E:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B1—9 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B21t—20 to 24 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films; neutral; clear smooth boundary.

IIB22t—24 to 28 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous clay films; about 5 percent pebbles by volume; neutral; abrupt smooth boundary.

IIB31t—28 to 34 inches; yellowish brown (10YR 5/6) gravelly loam; weak fine granular structure; friable; dark yellowish brown (10YR 4/4) thin patchy clay films; about 18 percent pebbles by volume; neutral; abrupt smooth boundary.

IIB32t—34 to 37 inches; reddish brown (5YR 4/4) gravelly loam; moderate medium subangular blocky structure; firm; thin patchy clay films; about 18 percent pebbles by volume; neutral; abrupt smooth boundary.

IIC—37 to 60 inches; yellowish brown (10YR 5/6) sand and gravel; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum and depth to the calcareous sand and gravel range from 24 to nearly 40 inches. The silty mantle is as thick as 24 inches. The Ap horizon is very dark grayish brown, dark brown, dark grayish brown, or grayish brown. Where uncultivated, the A1 horizon is 1 to 4 inches thick. Some pedons have an A2 horizon that is dark gray, grayish brown, or brown. The B1 horizon is dark yellowish brown, yellowish brown, or brown. Some pedons have no B1 horizon. The B2t horizon is dark brown or very dark grayish brown. It typically is clay loam or silty clay loam, but the range includes loam or sandy clay loam. The IIC horizon is sand, sand and gravel, or stratified sand and gravel. The substratum is mildly alkaline or moderately alkaline.

## Fabius series

The Fabius series consists of deep, somewhat poorly drained soils in depressions and drainageways on outwash plains. The soils are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They formed in loamy material over sand and gravel. Slope ranges from 0 to 3 percent.

Fabius soils are similar to Matherton soils and are commonly adjacent to Casco, Matherton, Mussey, and Wainola soils. Matherton soils are underlain by sand and gravel at a depth of 20 to 40 inches. Casco soils are well drained. Mussey soils are poorly drained. Wainola soils are sandy throughout.

Typical pedon of Fabius loam, 0 to 3 percent slopes, approximately 2,640 feet north and 2,640 feet west of SE corner of section 25, T. 22 N., R. 23 E:

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
A2—7 to 10 inches; brown (10YR 5/3) sandy loam; few fine faint grayish brown (10YR 5/2) and few fine prominent yellowish brown (10YR 5/6) mottles; weak medium platy structure parting to weak very fine subangular blocky; friable; neutral; clear wavy boundary.
B21t—10 to 16 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few thin patchy clay films; neutral; clear wavy boundary.
B22t—16 to 19 inches; brown (7.5YR 5/4) loam; common fine distinct yellowish brown (10YR 5/6) and few fine distinct light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; thin patchy clay films; about 7 percent pebbles by volume; mildly alkaline; abrupt wavy boundary.
IIC—19 to 60 inches; yellowish brown (10YR 5/4) sand and light gray (10YR 7/2) gravel; single grain; loose; slight effervescence; moderately alkaline.

The thickness of the solum and depth to sand and gravel range from 12 to 20 inches. The A1 horizon ranges from 3 to 8 inches in thickness. The A1 or Ap horizon is very dark gray or very dark brown. The Bt horizon is sandy loam, sandy clay loam, gravelly clay loam, clay loam, or loam. The IIC horizon is stratified sand and gravel, gravel, or coarse sand. The subsoil is neutral or mildly alkaline.

## Hortonville series

The Hortonville series consists of deep, well drained, moderately permeable soils on till plains. The soils formed in thin loess and in the underlying loamy calcareous till. Slope commonly ranges from 1 to 20 percent, but is up to 35 percent in complex with other soils.

Hortonville soils are similar to Kewaunee and Waymor soils and are commonly adjacent to Symco and Pella soils. Kewaunee soils have more clay in the lower part of the subsoil and in the substratum. Waymor soils have less clay in the lower part of the subsoil and in the substratum. Symco and Pella soils occupy depressions and drainageways and are somewhat poorly drained respectively.

Typical pedon of Hortonville silt loam, 1 to 6 percent slopes, approximately 1,420 feet west and 140 feet north of SE corner of section 4, T. 23 N., R. 24 E:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 6/1) dry; moderate fine subangular blocky structure; friable; common roots; neutral; abrupt smooth boundary.
B&A—9 to 11 inches; reddish brown (5YR 4/4) silty clay loam (Bt); moderate fine subangular blocky structure; firm; pale brown (10YR 6/3) silt loam (A2) that interfingers into and surrounds (Bt) peds; weak thin platy structure; friable; common roots; neutral; clear wavy boundary.
B21t—11 to 13 inches; reddish brown (5YR 4/4) silty clay loam; strong fine subangular blocky structure that has coatings on faces of some peds of pale brown (10YR 6/3) silt loam (A2); firm; common roots; neutral; clear smooth boundary.
B22t—13 to 16 inches; reddish brown (5YR 4/4) silty clay loam; strong fine subangular blocky structure; firm; common roots; few thin patchy clay films; neutral; clear smooth boundary.
B23t—16 to 21 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; thin continuous clay films; neutral; clear smooth boundary.
B23t—21 to 30 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous clay films; mildly alkaline; clear smooth boundary.
B3t—30 to 37 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; few thin patchy clay films; slight effervescence; mildly alkaline; diffuse wavy boundary.
C—37 to 60 inches; reddish brown (5YR 4/4) loam; massive; about 10 percent pebbles by volume; firm; strong effervescence; moderately alkaline.

The thickness of the solum and depth to free carbonates range from 24 to 40 inches. The solum and substratum are up to 25 percent gravel. The A1 horizon or Ap horizon is brown, dark brown, very dark grayish brown, or grayish brown. Some pedons have A2 horizons that are grayish brown, dark grayish brown, and pale brown. The B&A horizon has colors and textures of both the A2 horizon and the Bt horizon. The Bt horizon is typically reddish brown, but in some pedons it is brown or dark brown. It is silty clay loam, clay loam, or loam. The average clay content of the B horizon is 23 to 35 percent. Some pedons have thin subhorizons that are 35 to 45 percent clay. The C horizon is reddish brown or yellowish red. It is loam, clay loam, or silty clay loam. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Kewaunee series

The Kewaunee series consists of deep, well drained, moderately slowly permeable soils on till plains. The soils formed in thin loess and in the underlying clayey calcareous till. Slope ranges from 2 to 35 percent. In Kewaunee County, these soils have interfingering of A2 material into

the Bt horizon that is not defined for the series, but this difference does not alter their behavior.

Kewaunee soils are similar to Hortonville and Omro soils and are commonly adjacent to Kolberg, Manawa, Omro, and Poygan soils. Hortonville soils have less clay in the subsoil and substratum. Kolberg soils have dolomite at a depth of 20 to 40 inches. Omro soils are underlain by loamy material. Manawa and Poygan soils are in depressions and drainageways and are somewhat poorly drained and poorly drained, respectively.

Typical pedon of Kewaunee silt loam, 2 to 6 percent slopes, approximately 1,000 feet south and 30 feet east of NW corner of section 10, T. 25 N., R. 23 E:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine and medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

A2—7 to 8 inches; brown (10YR 4/3) silt loam, light gray (10YR 7/2) dry; weak medium and thick platy structure parting to weak very fine subangular blocky; friable; neutral; clear irregular boundary.

B&A—8 to 11 inches; reddish brown (5YR 4/3) silty clay loam (Bt); moderate fine and medium subangular blocky structure that is interfingered with brown (7.5YR 4/2) silt loam (A2); weak very fine and fine subangular blocky structure; firm; neutral; clear irregular boundary.

B21t—11 to 19 inches; reddish brown (5YR 4/3) silty clay; moderate and strong fine angular blocky structure; very firm; many thin clay films on faces of peds; neutral; clear wavy boundary.

B22t—19 to 24 inches; reddish brown (5YR 4/4) silty clay; moderate fine and medium angular blocky structure; very firm; many thin clay films on faces of peds; about 5 percent pebbles by volume; mildly alkaline; clear wavy boundary.

B23t—24 to 28 inches; reddish brown (5YR 4/4) silty clay; moderate fine and medium angular blocky structure; very firm; many thin clay films on faces of peds; about 5 percent pebbles by volume; slight effervescence; mildly alkaline; clear irregular boundary.

C—28 to 60 inches; reddish brown (5YR 5/4) silty clay; massive; very firm; about 5 percent pebbles by volume; violent effervescence; mildly alkaline.

The thickness of the solum and depth to underlying glacial till range from 20 to 40 inches. The A1 horizon or Ap horizon is dark brown, very dark brown, very dark grayish brown, very dark gray, or black. The Ap horizon is silt loam, silty clay loam, or silty clay. Some pedons have an A2 horizon that is dark grayish brown or brown. Some pedons have no A&B or B&A horizon. The Bt horizon is typically clay or silty clay, but in some pedons there are subhorizons of clay loam or silty clay loam. The C horizon is typically clay or silty clay but is silty clay loam or clay loam in some pedons. Clay content of the B horizon and C horizon ranges between 35 and 60 percent. The B horizon and C horizon are dark reddish brown, dark reddish gray, reddish gray, reddish brown, weak red, or dusky red. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Kibbie series

The Kibbie series consists of deep, somewhat poorly drained, moderately permeable soils on lake plains. The soils formed in silty and loamy calcareous lacustrine material. Slope ranges from 0 to 3 percent.

Kibbie soils are similar to Kibbie Variant soils and are commonly adjacent to Bach, Dresden, Matherton, Kibbie Variant, Shiocton, and Zurich soils. Kibbie Variant soils have more clay in the subsoil and occupy similar landscape positions. Bach soils occupy lower areas in the landscape and have no B2t horizon. Dresden soils occupy higher landscape positions and are underlain by sand and gravel. Matherton soils are on similar landscape positions and are underlain by sand and gravel. Shiocton soils occupy similar landscape positions and have no B2t horizon. Zurich soils are higher in the landscape and are well drained.

Typical pedon of Kibbie silt loam, 0 to 3 percent slopes, approximately 1,420 south and 2,600 feet east of NW corner of section 29, T. 22 N., R. 23 E:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.

A2—9 to 12 inches; grayish brown (10YR 5/2) silt loam; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.

B21t—12 to 19 inches; brown (10YR 4/3) silt loam; common fine and medium faint dark grayish brown (10YR 4/2) and common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; thin patchy clay films; neutral; clear wavy boundary.

B22t—19 to 25 inches; yellowish brown (10YR 5/4) loam; few fine distinct dark grayish brown (10YR 4/2) and common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; thin patchy clay films; neutral; clear wavy boundary.

B3t—25 to 27 inches; brown (10YR 5/3) loam; fine faint grayish brown (10YR 5/2) and common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; vesicular; thin patchy clay films; neutral; clear wavy boundary.

C1—27 to 42 inches; pale brown (10YR 6/3) silt; common fine faint light brownish gray (10YR 6/2) and common fine prominent brownish yellow (10YR 6/8) mottles; weak fine subangular blocky structure;

friable; slight effervescence; mildly alkaline; clear wavy boundary.

C2—42 to 60 inches; pale brown (10YR 6/3) silt; common fine faint light brownish gray (10YR 6/2) and common fine prominent brownish yellow (10YR 6/8) mottles; massive; friable; slight effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates range from 24 to 52 inches. The A1 horizon or Ap horizon is very dark brown, very dark grayish brown, very dark gray, or black. The B horizon is brown, dark brown, yellowish brown, or grayish brown. The Bt horizon is loam, clay loam, sandy clay loam, silty clay loam, or silt loam. The C horizon is brown, grayish brown, pale brown, or yellowish brown. It is silt or stratified silt and very fine sand or fine sand, and in some pedons there are strata of clay or silty clay. The substratum is mildly alkaline or moderately alkaline.

## Kibbie Variant

The Kibbie Variant consists of deep, somewhat poorly drained, slowly permeable over moderately permeable soils on lake plains. The soils are slowly permeable in the upper part and moderately permeable in the lower part. They formed in clayey and silty, calcareous lacustrine material. Slope ranges from 0 to 3 percent.

Kibbie Variant soils are similar to Kibbie soils and are commonly adjacent to Kibbie, Lamartine, Matherton, and Zurich soils. Kibbie soils have less clay in the subsoil. Lamartine soils are underlain by loamy glacial till. Matherton soils are underlain by sand and gravel at a depth of 20 to 40 inches. Zurich soils are well drained, have less clay in the subsoil, and occupy higher landscape positions.

Typical pedon of Kibbie Variant silt loam, 0 to 3 percent slopes, approximately 2,340 feet east and 30 feet south of NW corner of section 29, T. 22 N., R. 23 E:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

B21t—9 to 14 inches; dark brown (7.5YR 4/4) silty clay; few fine distinct pinkish gray (7.5YR 6/2) and strong brown (7.5YR 5/6) mottles; moderate very fine and fine angular blocky structure; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

B22t—14 to 21 inches; dark brown (7.5YR 4/4) silty clay; few fine distinct pinkish gray (7.5YR 6/2) and strong brown (7.5YR 5/6) mottles; moderate fine and medium angular blocky structure; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

B3t—21 to 25 inches; reddish brown (5YR 5/4) silty clay loam; common medium prominent light gray (10YR 6/1) and few medium prominent reddish yellow (5YR 6/8) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C1—25 to 42 inches; reddish brown (5YR 5/4) silt loam; few fine prominent light gray (10YR 6/1) and few medium prominent reddish yellow (5YR 6/8) mottles; weak medium subangular blocky structure; friable; violent effervescence; moderately alkaline; clear wavy boundary.

C2—42 to 60 inches; light reddish brown (5YR 6/4) stratified silt and very fine sand; few fine distinct pinkish gray (7.5YR 7/2) and common medium prominent yellowish red (5YR 5/8) mottles; few fine distinct pinkish white (5YR 8/2) calcium carbonate nodules; massive; friable; violent effervescence; moderately alkaline.

The thickness of the solum and depth to free carbonates range from 20 to 40 inches. The A horizon is very dark grayish brown or very dark brown. The Bt horizon is dark brown, brown, dark reddish brown, or reddish brown. In some pedons, the C horizon is stratified with thin bands of silt loam, fine sand, or clay. The substratum is mildly alkaline or moderately alkaline.

## Kolberg series

The Kolberg series consists of moderately deep, well drained, moderately slowly permeable soils on bedrock-controlled till plains. The soils formed in silty and clayey material overlying dolomite at a depth of 20 to 40 inches. Slope ranges from 1 to 12 percent.

Kolberg soils are commonly adjacent to Bonduel, Kewaunee, Kolberg Variant, and Manawa soils. Bonduel and Manawa soils occupy depressions and drainageways and are somewhat poorly drained. Manawa soils formed in till and have no dolomite. Kewaunee soils occupy similar landscape positions but formed in till and have no dolomite. Kolberg Variant soils occupy similar landscape positions and have dolomite at a depth of 10 to 20 inches.

Typical pedon of Kolberg silt loam, 1 to 6 percent slopes, approximately 1,200 feet east and 30 feet south of NW corner of section 4, T. 25 N., R. 23 E:

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 6/1) dry; weak fine and very fine subangular structure; very friable; neutral; clear wavy boundary.

A2—3 to 6 inches; pinkish gray (7.5YR 6/2) silt loam; weak thin and medium platy structure; friable; neutral; abrupt irregular boundary.

B&A—6 to 9 inches; reddish brown (5YR 4/4) silty clay (Bt) with tongues of pinkish gray (7.5YR 6/2) silt loam (A2); weak fine and medium subangular blocky structure; firm; neutral; clear irregular boundary.

B21t—9 to 12 inches; reddish brown (5YR 4/4) silty clay; strong fine subangular blocky structure; firm; thin continuous clay films; neutral; clear wavy boundary.

B22t—12 to 23 inches; reddish brown (5YR 4/4) clay; moderate fine and medium subangular blocky structure; firm; thin continuous clay films; neutral; clear wavy boundary.
B3t—23 to 31 inches; reddish brown (5YR 4/4) clay; moderate fine and medium subangular blocky structure; firm; thin continuous clay films; mildly alkaline; abrupt smooth boundary.
IIR—31 to 60 inches; dolomite bedrock.

The thickness of the solum and depth to dolomite range from 20 to 40 inches. The Ap horizon or A1 horizon is grayish brown, dark grayish brown, or very dark grayish brown. Some pedons have no A2 horizon. The A&B horizon and B&A horizon have tongues of A2 materials surrounding columnar peds of the B horizon or wholly surrounding small isolated remnants of B horizon. The tongues have texture, structure, and color like those of the overlying A2 horizon, and the remnants of the B horizon have structure and color like those of the underlying B2t horizon. The Bt horizon is dark reddish brown, reddish brown, or light reddish brown clay, silty clay, and, in some pedons, clay loam or silty clay loam. The Bt horizon is between 35 percent and 50 percent clay. The subsoil is neutral or mildly alkaline. In some places the dolomite has crevices that are filled with soil material.

## Kolberg Variant

The Kolberg Variant consists of shallow, well drained, moderately slowly permeable soils on bedrock-controlled till plains. The soils formed in silty and clayey material 10 to 20 inches thick over dolomite. Slope ranges from 1 to 6 percent.

Kolberg Variant soils are commonly adjacent to Bonduel, Kewaunee, Kolberg, and Namur soils. Bonduel soils occupy depressions and drainageways and are somewhat poorly drained. Kewaunee, Kolberg, and Namur soils occupy landscape positions similar to Kolberg Variant soils. Kewaunee soils formed in till and have no dolomite. Kolberg soils are 20 to 40 inches deep over dolomite. Namur soils have dolomite at a depth of 5 to 12 inches.

Typical pedon of Kolberg Variant silt loam, 1 to 6 percent slopes, approximately 600 feet south and 75 feet east of NW corner of section 30, T. 25 N., R. 24 E:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine and very fine granular structure; friable; neutral; abrupt smooth boundary.
A2—6 to 8 inches; reddish gray (5YR 5/2) silt loam; weak fine subangular blocky structure; friable; mildly alkaline; clear irregular boundary.
B&A—8 to 11 inches; reddish brown (5YR 4/4) silty clay (Bt) with interfingerings and coatings on some faces of peds of reddish gray (5YR 5/2) silt loam (A2); weak fine subangular blocky structure; firm; mildly alkaline; clear irregular boundary.
B2t—11 to 16 inches; reddish brown (5YR 4/4) silty clay; moderate fine subangular blocky structure; firm; thin continuous clay films; neutral; clear wavy boundary.
B3—16 to 18 inches; reddish brown (5YR 4/4) clay; moderate fine medium subangular blocky structure; firm; mildly alkaline; abrupt smooth boundary.
IIR—18 to 60 inches; dolomite bedrock.

The thickness of the solum and depth to dolomite range from 10 to 20 inches. The Ap horizon is dark grayish brown or very dark grayish brown. The A1 horizon in undisturbed areas is very dark gray or black. Some pedons do not have an A2 horizon. The Bt horizon is reddish brown or dark reddish brown. It is typically clay or silty clay, but in some pedons it is clay loam or silty clay loam. The subsoil is neutral or mildly alkaline.

## Lamartine series

The Lamartine series consists of deep, somewhat poorly drained, moderately permeable soils in depressions on till plains. The soils formed in loess and in the underlying calcareous loamy till. Slope ranges from 0 to 3 percent. In Kewaunee County, these soils have more sand in the upper part of the B horizon than is defined for the series, but this difference does not alter their behavior.

Lamartine soils are similar to Solona and Symco soils and are commonly adjacent to Pella and Waymor soils in the landscape. Solona and Symco soils are similar in drainage characteristics, but have a thinner mantle of silt loam. Pella soils are poorly drained and occupy lower landscape positions than Lamartine soils. Waymor soils are well drained and are higher than Lamartine soils.

Typical pedon of Lamartine silt loam, 0 to 3 percent slopes, approximately 175 feet east and 30 feet north of SW corner of section 33, T. 22 N., R. 23 E:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.
A2—8 to 13 inches; brown (10YR 4/3) silt loam; common fine prominent yellowish brown (10YR 5/8) and few fine faint dark grayish brown (10YR 4/2) mottles; weak thick platy structure parting to weak fine and very fine subangular blocky; very friable; vesicular; mildly alkaline; clear wavy boundary.
B21t—13 to 21 inches; dark brown (10YR 4/3) silt loam; common fine prominent strong brown (7.5YR 5/8) and common fine faint dark brown (7.5YR 4/2) mottles; moderate fine and medium subangular blocky structure; very friable; vesicular; few dark brown (10YR 3/3) thin patchy clay films; about 3 percent pebbles by volume, mostly less than 10mm in diameter; mildly alkaline; clear wavy boundary.
IIB22t—21 to 26 inches; dark brown (10YR 4/3) loam; common fine prominent strong brown (7.5YR 5/8)

and few fine prominent pinkish gray (7.5YR 7/2) mottles; moderate fine and medium subangular blocky structure; friable; few dark brown (10YR 3/3) thin patchy clay films; about 8 percent pebbles by volume, mostly less than 10mm in diameter; mildly alkaline; clear wavy boundary.

IIB3—26 to 33 inches; brown (7.5YR 5/4) loam; common fine prominent strong brown (7.5YR 5/8) and few fine distinct pinkish gray (7.5YR 7/2) mottles; weak fine and medium subangular blocky structure; friable; about 8 percent pebbles by volume, mostly less than 10mm in diameter; strong effervescence; mildly alkaline; clear wavy boundary.

IIC—33 to 60 inches; light brown (7.5YR 6/4) loam; common fine prominent reddish yellow (7.5YR 6/8) and few fine distinct pinkish gray (7.5YR 7/2) mottles; massive; friable; about 9 percent pebbles by volume, mostly less than 10mm in diameter; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. Thickness of the loess is 20 to 27 inches. Some pedons have a B1 horizon. The B21t horizon is silt loam or silty clay loam; the IIB22t horizon is loam or clay loam. Low-chroma mottles are few or common in the argillic horizons. The C horizon is typically loam, but is sandy loam in some pedons. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Longrie series

The Longrie series consists of moderately deep, well drained, moderately permeable soils on bedrock-controlled outwash plains and till plains. The soils formed in 20 to 40 inches of loamy, calcareous material overlying dolomite. Slope ranges from 2 to 6 percent. In Kewaunee County, these soils have an A2 horizon below the Bir horizon. This difference is outside the defined range for the series, but it does not alter their behavior.

Longrie soils are commonly adjacent to Bonduel, Onaway, Solona, and Namur soils. Bonduel and Solona soils occupy depressions and drainageways and are somewhat poorly drained. In addition, Solona soils formed in till and have no dolomite. Onaway soils occupy landscape positions similar to the Longrie soils but formed in till and have no dolomite. Namur soils occupy similar landscape positions and are shallow and very shallow over dolomite.

Typical pedon of Longrie loam, 2 to 6 percent slopes, approximately 1,840 feet east and 30 feet south of NW corner of section 5, T. 25 N., R. 25 E:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

B2ir—7 to 10 inches; dark brown (7.5YR 4/4) loam; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A'2—10 to 12 inches; brown (10YR 5/3) loam; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

B'2t—12 to 19 inches; reddish brown (5YR 4/4) sandy clay loam; weak fine subangular blocky structure; firm; thin patchy clay films; mildly alkaline; clear wavy boundary.

B'3t—19 to 24 inches; reddish brown (5YR 4/4) loam; weak fine and medium subangular blocky structure; friable; few thin patchy clay films; slight effervescence; mildly alkaline; clear smooth boundary.

C—24 to 28 inches; brown (7.5YR 5/4) loam; weak fine subangular blocky structure; friable; strong effervescence; moderately alkaline.

IIR—28 to 60 inches; dolomite bedrock.

The thickness of the solum and depth to dolomite range from 20 to 40 inches. The subsoil and substratum are less than 15 percent coarse fragments. The Ap horizon is dark brown, very dark gray, very dark grayish brown, or very dark brown. Where uncultivated, the A1 horizon is black, very dark brown, or very dark gray. Some pedons have an A2 horizon between the Ap or A1 horizon and a Bir horizon. The A2 horizon is brown, dark grayish brown, grayish brown, or light grayish brown. The Bir horizon is dark brown, dark yellowish brown, yellowish brown, and reddish brown. It is loam, fine sandy loam, or sandy loam. Some pedons have a Bhir horizon. Some pedons have an A2, A&B, or B&A horizon underlying the Bir horizon. The Bt horizon is sandy clay loam, loam, fine sandy loam, or sandy loam. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Manawa series

The Manawa series consists of deep, somewhat poorly drained, slowly permeable soils in depressions and drainageways on till plains. The soils formed in thin loess and the underlying clayey till. Slope ranges from 0 to 3 percent.

Manawa soils are similar to Symco soils and are commonly adjacent to Cathro, Kewaunee, and Poygan soils. Symco soils have less clay in the subsoil and substratum than Manawa soils. Cathro and Poygan soils are lower than the Manawa soils and are very poorly drained and poorly drained, respectively. Cathro soils have 16 to 51 inches of organic matter over a loamy substratum. Kewaunee soils occupy higher landscape positions and are well drained.

Typical pedon of Manawa silt loam, 0 to 3 percent slopes, approximately 2,240 feet east and 2,550 feet south of NW corner of section 30, T. 25 N., R. 23 E:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine and moderate subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

B21t—9 to 14 inches; reddish brown (5YR 4/4) silty clay loam; common fine and medium distinct brown (7.5YR 5/2) and few fine distinct yellowish red (5YR 5/6) mottles; weak fine and medium subangular blocky structure; firm; thin patchy clay films; mildly alkaline; clear wavy boundary.

B22t—14 to 23 inches; reddish brown (2.5YR 4/4) clay; few fine distinct reddish gray (5YR 5/2) and yellowish red (5YR 4/6) mottles; weak fine and medium subangular blocky structure; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

B23t—23 to 32 inches; reddish brown (2.5YR 4/4) clay; few fine distinct pinkish gray (5YR 5/2) and yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; firm; thin patchy clay films; slight effervescence; mildly alkaline; clear wavy boundary.

C—32 to 60 inches; reddish brown (2.5YR 4/4) clay; common fine distinct yellowish red (5YR 5/6) mottles; few fine prominent light gray (10YR 7/1) soft lime nodules; massive; firm; violent effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates range from 20 to 40 inches. The A1 horizon or Ap horizon is black, very dark brown, dark brown, very dark grayish brown, or very dark gray. Some pedons have an A2 horizon that is brown, dark brown, pinkish gray, light brownish gray, grayish brown, or dark grayish brown. It is silt loam, loam, or silty clay loam. The Bt horizon is silty clay loam, silty clay, or clay and is 35 to 60 percent clay. The C horizon is reddish brown, dark reddish brown, red, or dark red. It is clay loam, silty clay loam, silty clay, or clay. The content of pebbles ranges from slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

## Manistee series

The Manistee series consists of deep, well drained soils on lake plains and till plains. The soils are rapidly permeable in the upper part and slowly permeable in the lower part. They formed in sandy and loamy material and in the underlying clayey material. Slope ranges from 2 to 6 percent.

Manistee soils are similar to Menominee loamy substratum and Menominee Variant soils and are commonly adjacent to Allendale, Kewaunee, Oakville, and Wauseon soils. Menominee loamy substratum and Menominee Variant soils are underlain by loam till and gravelly sand, respectively. Allendale and Wauseon soils occupy depressions and are somewhat poorly drained and poorly drained, respectively. Kewaunee and Oakville soils occupy landscape positions similar to the Manistee soils. Kewaunee soils are not sandy above the subsoil. Oakville soils are sandy throughout.

Typical pedon of Manistee loamy fine sand, 2 to 6 percent slopes, approximately 1,460 feet west and 200 feet north of SE corner of section 7, T. 25 N., R. 23 E:

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak fine and very fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

B2ir—9 to 15 inches; dark brown (7.5YR 4/4) fine sand; weak fine and medium subangular blocky structure; very friable; neutral; clear wavy boundary.

A'2—15 to 27 inches; brown (10YR 5/3) fine sand; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.

B'21t—27 to 30 inches; brown (7.5YR 4/4) fine sandy loam; weak fine and medium subangular blocky structure; very friable; thin patchy clay coatings; neutral; clear wavy boundary.

IIB22t—30 to 32 inches; reddish brown (5YR 4/4) silty clay; weak fine and medium subangular blocky structure; firm; thin patchy clay coatings; neutral; clear wavy boundary.

IIC—32 to 60 inches; reddish brown (5YR 5/4) silty clay; massive; firm; violent effervescence; mildly alkaline.

The thickness of the solum ranges from 26 to 50 inches; the thickness of the sandy mantle ranges from 20 to 40 inches. The Ap horizon is very dark grayish brown, dark gray, dark brown, or dark grayish brown. Some pedons have an A2 horizon between the Ap horizon and B2ir horizon that is grayish brown, light brownish gray, brown, or pinkish gray. It is fine sand, sand, or loamy fine sand. The B2ir is dark grayish brown, brown, strong brown, dark brown, dark reddish brown, reddish brown, or dark reddish gray. Some pedons have a B22ir horizon. Chunks of ortstein are in some pedons. All pedons have an A'2 horizon below the Bir horizon or a tongued horizon or both. Some pedons do not have a B2t horizon. The IIBt horizon and IIC horizon are clay or silty clay. The sandy upper part of the subsoil ranges from slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

## Markey series

The Markey series consists of deep, very poorly drained, moderately rapidly permeable soils in depressions on outwash plains and stream valleys. The soils formed in organic deposits underlain by sandy material. Slope ranges from 0 to 2 percent.

Markey soils are similar to Cathro soils and are commonly adjacent to Carbondale, Cathro, Mussey, and Roscommon soils. Carbondale soils formed in organic deposits more than 51 inches deep. The organic horizons of Cathro soils are underlain by loamy material at a depth of 16 to 51 inches. Mussey and Roscommon soils are poorly drained mineral soils. They are slightly higher than Markey soils.

Typical pedon of Markey muck, approximately 1,640 feet east and 40 feet south of NW corner of section 17, T. 23 N., R. 24 E:

Oa1—0 to 5 inches; black (10YR 2/1) broken face and rubbed, sapric material; about 30 percent fiber, 5 percent rubbed, weak medium granular structure; primarily herbaceous fibers; neutral; abrupt smooth boundary.

Oa2—5 to 10 inches; black (10YR 2/1) broken face and rubbed, sapric material; about 20 percent fiber, 4 percent rubbed; weak coarse granular structure; primarily herbaceous fibers; some woody fragments mostly less than 1/4 inch in diameter; neutral; clear wavy boundary.

Oa3—10 to 20 inches; black (10YR 2/1) broken face and rubbed, sapric material; about 20 percent fiber, 2 percent rubbed; weak coarse granular structure; primarily herbaceous fibers with some woody fragments mostly less than 1/4 inch in diameter; neutral; clear irregular boundary.

Oa4—20 to 26 inches; dark reddish brown (5YR 2/2) broken face and black (10YR 2/1) rubbed, sapric material; about 20 percent fibers, 4 percent rubbed; weak coarse granular structure; primarily woody fragments less than 1/4 inch in diameter with many herbaceous fibers; numerous clean sand grains; neutral; abrupt wavy boundary.

IICg—26 to 60 inches; gray (10YR 5/1) fine sand; loose; single grain; neutral.

The thickness of the organic layers and depth to sandy material range from 16 to 51 inches. The organic layers are primarily sapric material derived from herbaceous plants, but include thin layers of primarily woody fragments in some pedons. These layers of woody fragments have a combined thickness of less than 10 inches. Thin layers of hemic material also are in some pedons. The IIC horizon is typically fine or medium sand which contains a few pebbles in some pedons. The organic layers are slightly acid or neutral; the substratum is neutral or mildly alkaline.

## Matherton series

The Matherton series consists of deep, somewhat poorly drained soils on outwash plains. The soils are moderately permeable in the upper part and very rapidly permeable in the lower part. They formed in loamy material and are underlain by sand and gravel. Slope ranges from 0 to 3 percent. In Kewaunee County, these soils are slightly redder in the lower part of the solum than is defined for the series and have no dominant colors with chroma of 2 or less in the argillic horizon, but these differences do not alter their behavior.

Matherton soils are commonly near Casco, Dresden, Fabius, and Mussey soils. Casco and Dresden soils are well drained. Fabius soils are thinner over sand and gravel. Mussey soils are poorly drained.

Typical pedon of Matherton silt loam, 0 to 3 percent slopes, appoximately 600 feet east and 50 feet south of NW corner of section 32, T. 23 N., R. 24 E:

A1—0 to 6 inches; very dark brown (10YR 2/2) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

A2—6 to 10 inches; grayish brown (10YR 5/2) very fine sandy loam; few fine prominent yellowish brown (10YR 5/6) mottles; few medium very dark brown (10YR 2/2) worm casts; weak medium platy structure parting to weak very fine subangular blocky; friable; neutral; clear smooth boundary.

B1—10 to 16 inches; dark yellowish brown (10YR 3/4) fine sandy loam; few fine prominent light brownish gray (10YR 6/2) mottles; weak thick platy structure parting to weak fine and very fine subangular blocky; friable; neutral; clear smooth boundary.

B2t—16 to 23 inches; dark brown (7.5YR 4/4) clay loam; few fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; thin patchy clay films; about 5 percent pebbles by volume; neutral; clear smooth boundary.

IIB3t—23 to 27 inches; dark brown (7.5YR 4/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; thin patchy clay films; about 15 percent pebbles by volume; mildly alkaline; clear smooth boundary.

IIC—27 to 60 inches; yellowish brown (10YR 5/4) sand and gravel; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 40 inches. The A1 horizon or Ap horizon is black, very dark grayish brown, or very dark brown. The A2 horizon is pale brown, brown, or grayish brown. Some pedons have no A2 horizon. The B2t horizon is sandy clay loam, loam, or clay loam. Low-chroma mottles are present at least in the upper part of the B2t horizon and, in some pedons, above the B2t horizon. The IIC horizon is gravel, gravelly sand, or stratified sand and gravel. It is mildly alkaline or moderately alkaline.

## Menominee series

The Menominee series consists of deep, well drained soils on till plains. The soils are rapidly permeable in the upper part and moderately permeable in the lower part. They formed in lacustrine or windblown sands and in the underlying loamy calcareous till. Slope ranges from 1 to 6 percent.

Menominee soils are similar to Manistee and Menominee Variant soils and are commonly adjacent to Hortonville, Oakville, Onaway, and Waymor soils. Manistee and Menominee Variant soils have clayey and gravelly sand substratums, respectively. Hortonville, Oakville, Onaway, and Waymor soils occupy similar landscape positions. Hortonville, Onaway, and Waymor soils are loamy throughout. Oakville soils are sandy throughout.

Typical pedon of Menominee loamy fine sand, loamy substratum, 1 to 6 percent slopes, approximately 1,800 feet west and 2,480 feet north of SE corner of section 17, T. 23 N., R. 24 E:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; slightly acid; abrupt wavy boundary.
B21hir—7 to 13 inches; dark brown (7.5YR 3/2) sand; single grain; large chunks of brittle ortstein material; medium acid; clear wavy boundary.
B22ir—13 to 23 inches; dark brown (7.5YR 4/4) sand; single grain; large chunks of brittle ortstein material; slightly acid; clear irregular boundary.
A'2—23 to 28 inches; brown (10YR 5/3) loamy sand; weak medium subangular blocky structure; firm; slightly acid; clear irregular boundary.
IIB2t—28 to 33 inches; reddish brown (5YR 4/4) loam; some brown (10YR 5/3) A2 coatings on faces of peds; weak medium subangular blocky structure; friable; few thin patchy clay films; neutral; clear irregular boundary.
IIB3—33 to 42 inches; brown (7.5YR 5/4) loam; weak fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear irregular boundary.
IIC—42 to 60 inches; light brown (7.5YR 6/4) loam; weak fine and very fine subangular blocky structure; friable; estimate 15 percent clay; slight effervescence; mildly alkaline.

The thickness of the sandy mantle and depth to the IIBt horizon range from 20 to 40 inches. The A1 horizon and Ap horizon are black, very dark brown, very dark gray, very dark grayish brown, dark brown, and dark grayish brown. Uncultivated pedons have a pinkish gray A2 horizon. In some pedons there is no B21hir horizon. The B2ir horizon is dark brown, brown, strong reddish brown, or dark reddish brown. Ortstein materials occur throughout the Bir horizon in many pedons. The A'2 horizon underlying the Bir horizon occurs as a separate horizon or as part of an A&B horizon. The IIBt horizon is sandy clay loam, loam, or clay loam. The IIC horizon typically is loam, but is sandy clay loam in some pedons. The sandy upper part of the subsoil ranges from strongly acid to slightly acid; the loamy part of the subsoil and substratum ranges from medium acid to mildly alkaline.

## Menominee Variant

The Menominee Variant consists of deep, well drained to excessively drained soils on outwash plains. The soils are moderately permeable in the upper part and very rapidly permeable in the lower part. They formed in sandy and loamy lacustrine or windblown sediment underlain by gravelly sand. Slope ranges from 1 to 6 percent.

Menominee Variant soils are similar to Menominee loamy substratum soils and are commonly adjacent to Casco and Oakville soils. Menominee loamy substratum soils are underlain by loamy till. Casco soils have a loamy solum and are thinner over sand and gravel than the Menominee Variant soils. Oakville soils are sandy throughout. Casco and Oakville soils also do not have bisequal profiles.

Typical pedon of Menominee Variant loamy fine sand, 1 to 6 percent slopes, approximately 960 feet west and 660 feet south of NE corner of section 30, T. 23 N., R. 24 E:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium and coarse subangular blocky structure; very friable; neutral; abrupt smooth boundary.
B21ir—9 to 13 inches; strong brown (7.5YR 5/6) fine sand; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.
B22ir—13 to 25 inches; reddish yellow (7.5YR 6/6) fine sand; single grain; loose; neutral; abrupt wavy boundary.
A'2—25 to 32 inches; pale brown (10YR 6/3) fine sand; weak thick platy structure parting to weak very fine subangular blocky; very friable; neutral; clear wavy boundary.
IIB21t—32 to 35 inches; dark yellowish brown (10YR 4/4) loam; weak fine and medium subangular blocky structure; friable; thin patchy clay films; about 5 percent pebbles by volume; neutral; clear wavy boundary.
IIB22t—35 to 38 inches; dark brown (7.5YR 4/4) loam; weak fine subangular blocky structure; friable; thin patchy clay films; about 5 percent pebbles by volume; neutral; abrupt wavy boundary.
IIC—38 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 25 percent pebbles by volume; slight effervescence; mildly alkaline.

The thickness of the sandy mantle and depth to the IIBt horizon range from 20 to 40 inches. The A1 horizon or Ap horizon is very dark gray, very dark grayish brown, very dark brown, or black. Some pedons have an A2 horizon. The B2ir horizon is dark brown, brown, strong brown, or reddish yellow. Fragments or layers of ortstein are present in some pedons. The A'2 horizon may be a distinct horizon or may be only coatings on the faces of peds in the IIBt horizon. The IIBt horizon typically is loam but is sandy clay loam or silt loam in some pedons. The IIC horizon is gravel, stratified sand and gravel, or gravelly sand. The substratum is neutral or mildly alkaline.

## Mosel series

The Mosel series consists of deep, somewhat poorly drained, moderately slowly permeable soils on lake plains and till plains. The soils formed in loamy material. Slope ranges from 0 to 3 percent.

The Mosel series is commonly adjacent to Manawa and Poygan soils. Manawa soils occupy similar landscape positions but contain more clay in the lower part of the subsoil and in the substratum. Poygan soils occupy lower landscape positions and are poorly drained.

Typical pedon of Mosel loam, 0 to 3 percent slopes, approximately 1,150 feet east and 100 feet south of NW corner of section 29, T. 22 N., R. 23 E:

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

B1—9 to 16 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.

B21t—16 to 20 inches; brown (7.5YR 5/4) sandy loam; few fine distinct brown (7.5YR 5/2) and strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; very friable; some clay bridging of sand grains; mildly alkaline; clear smooth boundary.

IIB22t—20 to 28 inches; reddish brown (5YR 5/4) silty clay loam; few fine distinct pinkish gray (5YR 7/2) and yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

IIC—28 to 60 inches; light brown (7.5YR 6/4) silty clay loam; few fine prominent light gray (N 7/0) and few fine distinct, strong brown (7.5YR 5/6) mottles; massive; firm; strong effervescence; mildly alkaline.

The thickness of the solum and depth to carbonates range from 24 to 36 inches. The A1 or Ap horizon is black, very dark brown, very dark gray, very dark grayish brown, or dark brown. Some pedons have a dark grayish brown, grayish brown, or brown A2 horizon. The B1 horizon is brown, dark brown, dark yellowish brown, or yellowish brown. It is loam or sandy loam. The B2t horizon is sandy clay loam, clay loam, sandy loam, or loam. The IIB2t horizon is silty clay loam or silty clay. The clay content ranges from 10 to 35 percent in the B2t horizon and from 27 to 45 percent in the IIB2t horizon. The IIC horizon is silty clay loam or silty clay. In some pedons there are thin layers of silt, silt loam, fine sand, or clay. The subsoil is slightly acid to mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Mussey series

The Mussey series consists of deep, poorly drained soils in drainageways and depressions on outwash plains. The soils are moderately permeable in the upper part and rapidly permeable in the lower part. They formed in loamy material overlying calcareous sand and gravel. Slope ranges from 0 to 2 percent. In Kewaunee County, these soils do not have mottles throughout the B horizon as defined for the series, but this difference does not alter their behavior.

Mussey soils are commonly adjacent to Casco, Fabius, and Markey soils. Casco soils are well drained and occupy higher landscape positions than Mussey soils. Fabius soils are somewhat poorly drained and are also higher than Mussey soils. Markey soils are very poorly drained organic soils underlain by fine sand. They occupy large depressions.

Typical pedon of Mussey loam, approximately 75 feet west and 270 feet north of SE corner of section 30, T. 23 N., R. 24 E:

Ap—0 to 11 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate coarse granular structure; friable; mildly alkaline; abrupt smooth boundary.

B21tg—11 to 16 inches; dark gray (10YR 4/1) loam; moderate medium and coarse subangular blocky structure; firm; thin patchy clay films; about 4 percent pebbles by volume; mildly alkaline; abrupt smooth boundary.

B22tg—16 to 17 inches; dark gray (10YR 4/1) loam; moderate medium subangular blocky structure; firm; few thin patchy clay films; about 15 percent pebbles by volume; neutral; clear smooth boundary.

B3g—17 to 19 inches; dark grayish brown (2.5Y 4/2) gravelly loam; few medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; about 25 percent pebbles by volume; slight effervescence; mildly alkaline; clear irregular boundary.

Cg—19 to 60 inches; gray (5Y 5/1) gravelly sand; single grain; about 40 percent pebbles by volume; loose; strong effervescence; mildly alkaline.

The thickness of solum ranges from 14 to 20 inches. Matrix colors of the Bg horizon are gray, grayish brown, dark gray, or dark grayish brown. The B2g horizon is loam, sandy clay loam, or clay loam. The lower part of the B horizon is gravelly loam or gravelly sandy clay loam in most pedons. The C horizon is gravelly sand or dominantly gravel or dominantly sand. The subsoil is slightly acid or mildly alkaline.

## Namur series

The Namur series consists of very shallow and shallow, well drained, moderately permeable soils on bedrock-controlled uplands. The soils formed in loamy material overlying dolomite at a depth of 5 to 12 inches. Slope commonly ranges from 1 to 6 percent, but is up to 20 percent in complex with Rock outcrop.

Namur soils are similar to Ruse soils and are commonly adjacent to Kolberg Variant soils. Ruse soils are poorly drained and have dolomite at a depth of 10 to 20 inches.

Kolberg Variant soils occupy landscape positions similar to those of the Namur soils. They have dolomite at a depth of 10 to 20 inches, and they contain more clay than Namur soils.

Typical pedon of Namur loam, 1 to 6 percent slopes, approximately 2,310 feet east and 1,100 feet south of NW corner of section 32, T. 24 N., R. 24 E:

A1—0 to 5 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak very fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.
B2—5 to 7 inches; brown (7.5YR 4/4) loam; many medium very dark brown (10YR 2/2) worm casts; weak fine subangular blocky structure; friable; mildly alkaline; abrupt wavy boundary.
R—7 to 60 inches; dolomite bedrock.

The thickness of the solum and depth to dolomite range from 5 to 12 inches. The subsoil is loam or silt loam. The solum is slightly acid to mildly alkaline. In some places the dolomite has crevices filled with soil material.

## Nichols series

The Nichols series consists of deep, well drained, moderately permeable soils on lake plains. The soils formed in loamy material underlain by stratified silt and very fine sand. Slope ranges from 1 to 6 percent.

Nichols soils are similar to Boyer and Zurich soils and are commonly adjacent to Boyer, Kibbie, and Zurich soils. Boyer soils have a Bt horizon and are underlain by sand and gravel. Kibbie and Zurich soils also have a Bt horizon. Kibbie soils also are somewhat poorly drained and are in lower landscape positions.

Typical pedon of Nichols fine sandy loam, 1 to 6 percent slopes, approximately 1,800 feet south and 30 feet east of NW corner of section 8, T. 22 N., R. 24 E:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; many roots; mildly alkaline; abrupt smooth boundary.
B1—7 to 19 inches; dark brown (7.5YR 4/4) fine sandy loam; weak medium subangular blocky structure; very friable; few roots; mildly alkaline; clear wavy boundary.
B21—19 to 24 inches; dark yellowish brown (10YR 4/4) very fine sandy loam; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.
B22—24 to 27 inches; dark brown (7.5YR 4/4) silt loam; moderate medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.
C1—27 to 54 inches; yellowish brown (10YR 5/4) very fine sand; massive; very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.
C2—54 to 60 inches; yellowish brown (10YR 5/4) stratified silt and very fine sand; massive; very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 36 inches. The B horizon is brown, dark brown, strong brown, yellowish brown, or dark yellowish brown. Some pedons have thin subhorizons of medium sand or a few pebbles in the B horizon. The C horizon is typically stratified silt and very fine sand, but in some pedons there are thin layers of medium sand, gravel, or silty clay. The subsoil is neutral to moderately alkaline.

## Oakville series

The Oakville series consists of deep, well drained, rapidly permeable soils on low sand dunes, beach ridges, and lake plains. The soils formed in sandy lacustrine or windblown sediment. Slope ranges from 1 to 12 percent.

The Oakville soils are commonly associated with Allendale, Manistee, Menominee loamy substratum, Menominee Variant, and Wainola soils. Allendale and Wainola soils occupy depressions and drainageways and are somewhat poorly drained. Manistee, Menominee loamy substratum, and Menominee Variant soils occupy similar landscape positions. They are underlain by clayey till, loamy till, or gravelly sand, respectively.

Typical pedon of Oakville loamy fine sand, 6 to 12 percent slopes, approximately 1,370 feet south and 150 feet east of NW corner of section 21, T. 23 N., R. 24 E:

Ap—0 to 7 inches; dark brown (7.5YR 3/2) loamy fine sand, brown (10YR 4/3) dry; single grain; loose; many roots; neutral; abrupt smooth boundary.
B21—7 to 11 inches; brown (7.5YR 4/4) fine sand; single grain; loose; many roots; neutral; clear wavy boundary.
B22—11 to 18 inches; strong brown (7.5YR 5/6) fine sand; single grain; loose; few roots; slightly acid; clear wavy boundary.
B3—18 to 22 inches; reddish yellow (7.5YR 6/6) fine sand; single grain; loose; few roots; slightly acid; gradual wavy boundary.
C—22 to 60 inches; reddish yellow (7.5YR 6/6) fine sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 18 to 36 inches. The Ap horizon is brown, dark brown, very dark grayish brown, dark grayish brown, or dark yellowish brown. The B2 horizon is very dark brown, brown, strong brown, light brown, or reddish yellow. Some pedons are as much as 50 percent medium sand and, to a much lesser extent, coarse sand with a few pebbles. The subsoil and substratum is medium acid to neutral.

## Omro series

The Omro series consists of deep, well drained soils on till plains. The soils are slowly permeable in the upper part and moderately permeable in the lower part. They formed in thin loess overlying clayey calcareous till and in the underlying loamy calcareous till. Slope ranges from 1 to 12 percent. In Kewaunee County, these soils have albic material interfingering into the argillic horizon. This is not definitive of the Omro series, but does not alter soil behavior.

Omro soils are similar to Hortonville soils and are commonly adjacent to Hortonville, Kewaunee, Manawa, and Waymor soils. Hortonville, Kewaunee, and Waymor soils occupy similar landscape positions. Hortonville and Waymor soils have less clay in the subsoil. Kewaunee soils have more clay in the lower part of the subsoil and substratum. Manawa soils have more clay in the lower part of the subsoil and substratum, are somewhat poorly drained, and are lower on the landscape.

Typical pedon of Omro silt loam, 1 to 6 percent slopes, approximately 1,660 feet west and 30 feet north of SE corner of section 13, T. 25 N., R. 23 E:

Ap—0 to 6 inches; dark brown (7.5YR 3/2) silt loam, pinkish gray (5YR 6/2) dry; weak fine granular structure; friable; mildly alkaline; abrupt smooth boundary.

B&A—6 to 9 inches; reddish brown (2.5YR 4/4) clay (Bt); moderate fine subangular blocky structure that is interfingered by or has ped coatings of brown (7.5YR 5/2) silt loam (A2); firm; mildly alkaline; clear irregular boundary.

B21t—9 to 20 inches; reddish brown (2.5YR 4/4) clay; moderate fine angular blocky structure; firm; thin continuous clay films; mildly alkaline; clear wavy boundary.

B22t—20 to 27 inches; reddish brown (2.5YR 4/4) clay; moderate fine subangular blocky structure; firm; thin continuous clay film; moderately alkaline; abrupt wavy boundary.

IIB3t—27 to 30 inches; reddish brown (5YR 4/4) loam; weak fine subangular blocky structure; friable; thin patchy clay films; about 8 percent pebbles by volume; moderately alkaline; clear wavy boundary.

IIC—30 to 60 inches; brown (7.5YR 5/4) loam; weak fine subangular blocky structure; friable; about 14 percent pebbles by volume; strong effervescence; moderately alkaline.

The thickness of the solum and depth to free carbonates range from 24 to 39 inches. The Ap horizon is grayish brown, dark grayish brown, very dark grayish brown, dark brown, or brown. It is silt loam or silty clay loam. Where present, the A2 horizon is brown, dark brown, dark grayish brown, and grayish brown. The B&A horizon has colors and characteristics of both the overlying A2 horizon and the underlying B2t horizon. Some pedons have no B&A horizon. The B2t horizon is reddish brown or dark reddish brown. It is silty clay or clay but has thin subhorizons of clay loam or silty clay loam in some pedons. The B2t horizon is between 35 to 60 percent clay. Some pedons have low-chroma mottles in the lower part of the B2t horizon. The IIB3t horizon is loam or clay loam. Some pedons do not have a IIB3t horizon. The IIC horizon is loam, sandy loam, or fine sandy loam. The upper part of the subsoil is slightly acid to mildly alkaline; the lower part is mildly alkaline or moderately alkaline. The substratum is mildly alkaline or moderately alkaline.

## Onaway series

The Onaway series consists of deep, well drained, moderately permeable soils on till plains. The soils formed in loamy, calcareous till. Slope ranges from 1 to 12 percent. In Kewaunee County, these soils contain less clay in the solum and C horizon than is defined for the series, but this difference does not alter their behavior.

Onaway soils are commonly adjacent to Angelica, Hortonville, Longrie, and Solona soils. Angelica and Solona soils occupy depressions and drainageways. They are poorly drained and somewhat poorly drained, respectively. Hortonville and Longrie soils occupy landscape positions similar to Onaway soils. Hortonville soils typically have a thicker solum. Longrie soils are underlain by dolomite at a depth of 20 to 40 inches.

Typical pedon of Onaway loam, 1 to 6 percent slopes, approximately 1,600 feet south and 30 feet east of the NW corner of section 21, T. 25 N., R. 25 E:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine and very fine granular structure; very friable; neutral; abrupt smooth boundary.

B2ir—8 to 13 inches; dark brown (7.5YR 4/4) loam; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

A'2—13 to 15 inches; pinkish gray (5YR 6/2) sandy loam; weak fine subangular blocky structure; friable; about 5 percent pebbles by volume; neutral; clear irregular boundary.

B&A'—15 to 18 inches; reddish brown (5YR 4/4) loam (Bt); weak medium subangular blocky structure that has interfingers and ped coatings of pinkish gray (5YR 6/2) sandy loam (A2); friable; about 5 percent pebbles by volume; brittle when dry; vesicular; neutral; clear irregular boundary.

B'2—18 to 25 inches; reddish brown (5YR 4/4) loam; weak fine subangular blocky structure; friable; about 8 percent pebbles by volume; slight effervescence; mildly alkaline; clear wavy boundary.

B'3—25 to 28 inches; reddish brown (5YR 5/4) loam; weak fine subangular blocky structure; friable; about 8 percent pebbles by volume; strong effervescence; mildly alkaline; clear wavy boundary.

C—28 to 60 inches; light reddish brown (5YR 6/4) sandy loam; few fine distinct reddish yellow (5YR 6/6) mottles; massive; friable; about 10 percent pebbles by volume; violent effervescence; mildly alkaline.

The thickness of the solum ranges from 15 to 30 inches. The Ap or A1 horizon is black, very dark brown, very dark gray, or very dark grayish brown. Where present, the A1 horizon ranges from 1 to 3 inches in thickness. Some pedons have a fine sandy loam A2 horizon above the Bir horizon. The B2ir horizon is fine sandy loam or loam. Some pedons have no A'2 horizon underlying the Bir horizon; however, all pedons have an A&B horizon or B&A horizon. The A part of this horizon is loamy fine sand, loamy sand, fine sandy loam or sandy loam. The B part of the A&B or B&A horizon is like the underlying B horizon. The B horizon is loam, clay loam, or silty clay loam. It is dark brown, reddish brown, or dark reddish brown. The C horizon is loam, silt loam, or sandy loam. Volume of pebbles ranges up to 10 percent. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Pella series

The Pella series consists of deep, poorly drained, moderately permeable soils in depressions and drainageways on till plains. The soils formed in silty material and in the underlying loamy till. Slope ranges from 0 to 2 percent. These soils are redder in the C horizon than is defined for the series, but this difference does not alter their behavior.

Pella soils are similar to Angelica soils and are commonly adjacent to Carbondale, Cathro, Hortonville, Lamartine, Symco, and Waymor soils. Angelica soils have a thinner solum than the Pella soils. Carbondale and Cathro soils occupy lower areas on the landscape and formed in organic deposits. Hortonville, Lamartine, Symco, and Waymor soils occupy higher landscape positions. Hortonville and Waymor soils are well drained. Lamartine and Symco soils are somewhat poorly drained.

Typical pedon of Pella silt loam, approximately 2,300 feet north and 2,690 feet east of the SW corner of section 23, T. 22 N., R. 23 E:

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; common roots; mildly alkaline; abrupt smooth boundary.

A12—7 to 14 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; few roots; mildly alkaline; clear wavy boundary.

B1g—14 to 18 inches; dark gray (5Y 4/1) silt loam; gray (10YR 6/1) silt coatings on faces of peds; weak medium and coarse subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

B2g—18 to 27 inches; dark gray (5Y 4/1) silt loam; weak fine and medium subangular blocky structure; firm; mildly alkaline; clear wavy boundary.

IIB3g—27 to 30 inches; gray (5Y 5/1) loam; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

IIC—30 to 60 inches; light brown (7.5YR 6/4) loam; few fine distinct pinkish gray (7.5YR 6/2) and common fine prominent strong brown (7.5YR 5/8) mottles; massive; firm; violent effervescence; mildy alkaline.

The thickness of the solum ranges from 30 to 42 inches. The thickness of the silty overburden is normally less than 40 inches. The mollic epipedon ranges from 12 to 24 inches in thickness. The B horizon typically is dark gray or gray silt loam or silty clay loam. The IIC horizon is loam or clay loam. The subsoil and substratum is mildly alkaline or moderately alkaline.

## Poygan series

The Poygan series consists of deep, poorly drained, slowly permeable soils in depressions and drainageways on lake plains and till plains. The soils formed mostly in clayey, calcareous lacustrine or till material. Slope ranges from 0 to 2 percent.

Poygan soils are commonly adjacent to Carbondale, Cathro, Kewaunee and Manawa soils. Carbondale and Cathro soils occupy lower landscape positions and are formed in organic deposits. Kewaunee and Manawa soils occupy higher landscape positions. Kewaunee soils are well drained. Manawa soils are somewhat poorly drained.

Typical pedon of Poygan silty clay loam, approximately 1,890 feet west and 320 feet north of SE corner of section 31, T. 25 N., R. 23 E:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; firm; mildly alkaline; abrupt smooth boundary.

B1g—9 to 13 inches; dark gray (10YR 4/1) silty clay; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; firm; mildly alkaline; clear wavy boundary.

B21—13 to 19 inches; reddish brown (5YR 5/3) clay; common medium distinct gray (5YR 5/1) and common fine prominent yellowish red (5YR 5/6) mottles; weak fine and medium subangular blocky structure; firm; mildly alkaline; clear wavy boundary.

B22—19 to 27 inches; reddish brown (5YR 5/3) clay; few fine distinct gray (5YR 5/1) mottles and common fine prominent yellowish red (5YR 5/6) mottles; weak fine angular blocky structure; firm; mildly alkaline; clear wavy boundary.

C—27 to 60 inches; reddish brown (5YR 5/4) clay; common fine distinct yellowish red (5YR 5/6) mottles; few fine prominent pink (5YR 7/3) calcium carbonate nodules; weak fine and medium subangular

blocky structure; firm; violent effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 36 inches. The A horizon is black or very dark gray. The B1g horizon is silty clay loam or silty clay. The B horizon and C horizon are between 35 and 60 percent clay. Volume of pebbles in the B and C horizons is commonly less than 5 percent. The C horizon is silty clay or clay. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Rodman series

The Rodman series consists of deep, excessively drained, very rapidly permeable soils on outwash plains and moraines. The soils formed in gravelly loamy material underlain by calcareous sand and gravel. Slope ranges from 2 to 35 percent. In Kewaunee County, these soils have a thinner subsoil than is defined for the series, but this difference does not alter their behavior.

Rodman soils are near Casco, Dresden, Fabius, and Matherton soils, all of which have a thicker solum and more clay in the subsoil than Rodman soils. Casco and Dresden soils occupy similar landscape positions. Fabius and Matherton soils are somewhat poorly drained and occupy depressions and drainageways.

Typical pedon of Rodman gravelly sandy loam, from an area of Rodman-Casco complex, 20 to 35 percent slopes, approximately 2,640 feet west and 1,750 feet south of NE corner of section 30, T. 23 N., R. 24 E:

Ap—0 to 6 inches; dark brown (10YR 3/3) gravelly sandy loam, brown (10YR 5/3) dry; moderate fine and very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

B2—6 to 9 inches; dark brown (7.5YR 4/4) gravelly sandy loam; single grain; loose; neutral; abrupt smooth boundary.

C1—9 to 12 inches; light yellowish brown (10YR 6/4) coarse and very coarse sand; about 8 percent fine and very fine gravel by volume; single grain; loose; slight effervescence; mildly alkaline; clear smooth boundary.

C2—12 to 60 inches; light yellowish brown (10YR 6/4) coarse sand and gravel; single grain; loose; about 35 percent gravel by volume; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 8 to 15 inches. The A horizon is very dark brown, very dark grayish brown, or dark brown. The B horizon is brown, dark brown, or dark yellowish brown. It is gravelly loam or gravelly sandy loam. The C horizon is gravel or coarse sand and gravel. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Roscommon series

The Roscommon series consists of deep, poorly drained and very poorly drained, rapidly permeable soils on lake plains. The soils formed in sandy lacustrine material. Slope ranges from 0 to 2 percent.

Roscommon soils are commonly adjacent to Carbondale, Fabius, Markey, Mussey, and Wainola soils. Carbondale and Markey soils occupy lower landscape positions and formed in organic deposits. Fabius and Wainola soils occupy higher landscape positions and are somewhat poorly drained. Mussey soils occupy landscape positions similar to Roscommon soils, but are underlain by gravelly sand and have a Bt horizon.

Typical pedon of Roscommon mucky loamy sand, approximately 2,440 feet west and 2,400 feet north of SE corner of section 15, T. 25 N., R. 23 E:

A1—0 to 9 inches; black (10YR 2/1) mucky loamy sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.

C1g—9 to 24 inches; dark gray (10YR 4/1) loamy sand; single grain; loose; mildly alkaline; clear wavy boundary.

C2—24 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; mildly alkaline.

The A1 or Ap horizon is black, very dark gray, or very dark brown. The A1 horizon ranges from 6 to 16 inches in thickness. The C horizon is dark gray, dark grayish brown, grayish brown, gray, light gray, light brownish gray, pinkish gray, or brown. Reaction is slightly acid to mildly alkaline throughout.

## Ruse series

The Ruse series consists of shallow, poorly drained, moderately permeable soils in depressions on bedrock-controlled till plains. The soils formed in loamy and sandy material and are underlain by dolomite at a depth of 10 to 20 inches. Slope ranges from 0 to 2 percent. In Kewaunee County, these soils have a thicker dark A horizon than is defined for the series, but this difference does not alter their behavior.

Ruse soils are commonly associated with Angelica, Bonduel, Longrie, and Namur soils. Angelica soils occupy similar landscape positions and are more than 60 inches deep over dolomite. Bonduel and Longrie soils are underlain by dolomite at a depth of 20 to 40 inches. Bonduel is somewhat poorly drained. Longrie and Namur are well drained. Namur soils are underlain by dolomite at a depth of 5 to 12 inches.

Typical pedon of Ruse loam, approximately 1,300 feet east and 75 feet south of NW corner of section 27, T. 25 N., R. 23 E:

A11—0 to 4 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak

medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.
A12—4 to 9 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.
B21g—9 to 12 inches; gray (10YR 5/1) fine sandy loam; weak fine and medium subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.
B22—12 to 14 inches; brown (7.5YR 5/4) loamy fine sand; few fine distinct brown (7.5YR 5/2) and common fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; slight effervescence; mildly alkaline; abrupt wavy boundary.
IIR—14 to 60 inches; dolomite bedrock.

The thickness of the solum and depth to dolomite range from 10 and 20 inches. The B horizon is typically fine sandy loam, silt loam, or loam with some thin horizons of loamy fine sand, silty clay loam, or clay loam. Some pedons have a thin layer of organic matter over the A horizon. The A horizon is black, very dark brown, very dark gray, or very dark grayish brown and ranges from 5 to 10 inches in thickness. The Bg horizon has chroma of 1 or 2. Some pedons have a thin C horizon. The upper few inches of dolomite are soft and weathered in some pedons. The subsoil is slightly acid to mildly alkaline.

## Shiocton series

The Shiocton series consists of deep, somewhat poorly drained, moderately permeable soils on lake plains. The soils formed in silty and sandy, calcareous lacustrine material. Slope ranges from 0 to 3 percent.

Shiocton soils are commonly adjacent to Bach, Kibbie, Nichols, and Zurich soils. Bach soils occupy lower areas in the landscape and are poorly drained. Kibbie soils occupy landscape positions similar to Shiocton soils. They have a Bt horizon. Nichols and Zurich soils occupy higher landscape positions and are well drained. Zurich soils also have a Bt horizon.

Typical pedon of Shiocton silt loam, 0 to 3 percent slopes, approximately 313 feet west and 680 feet south of NE corner of section 20, T. 23 N., R. 24 E:

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; medium fine subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.
B1—9 to 11 inches; light yellowish brown (10YR 6/4) silt loam; few fine distinct light gray (10YR 7/2) and common fine distinct brownish yellow (10YR 6/6) mottles; common medium black (10YR 2/1) worm casts; weak thin platy structure; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.
B2—11 to 16 inches; light brown (7.5YR 6/4) silt loam; few fine distinct white (10YR 8/2) and common fine prominent reddish yellow (7.5YR 6/8) mottles; common medium black (10YR 2/1) worm casts; weak thin platy structure; very friable; strong effervescence; mildly alkaline; clear wavy boundary.
B3—16 to 25 inches; light reddish brown (5YR 6/4) stratified silt and very fine sand; few fine distinct pinkish white (5YR 8/2) and many medium distinct reddish yellow (7.5YR 6/6) mottles; weak thick platy structure parting to weak fine and very fine subangular blocky; very friable; violent effervescence; moderately alkaline; gradual wavy boundary.
C—25 to 60 inches; light reddish brown (5YR 6/3) stratified silt and very fine sand; few fine distinct pinkish white (5YR 8/2) and few fine prominent reddish yellow (7.5YR 6/6) mottles; weak thin platy structure; very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 36 inches. The thickness of the mollic epipedon ranges from 8 to 15 inches. Most pedons are calcareous almost to the surface, but some are leached as deep as 30 inches. The A1 or Ap horizon is black, very dark brown, dark brown, very dark grayish brown, or very dark gray. In some pedons, thin layers of silt loam, fine sandy loam, sand, or clay occur in the C horizon below a depth of 40 inches. The subsoil ranges from slightly acid to mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Solona series

The Solona series consists of deep, somewhat poorly drained, moderately permeable soils in depressions and drainageways on till plains. The soils formed mostly in loamy, calcareous till. Slope ranges from 0 to 3 percent.

Solona soils are similar to Lamartine and Symco soils and commonly adjacent to Angelica, Cathro, and Onaway soils. Lamartine soils have a thicker silty mantle. Symco soils contain more clay in the subsoil. Angelica soils occupy lower landscape positions and are poorly drained. Cathro soils occupy lower, landscape positions, are very poorly drained, and are formed in 16 to 51 inches of organic deposits over loamy material. Onaway soils occupy higher landscape positions and are well drained.

Typical pedon of Solona silt loam, 0 to 3 percent slopes, approximately 640 feet west and 60 feet south of NE corner of section 3, T. 25 N., R. 25 E:

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.
B21t—9 to 17 inches; reddish brown (5YR 5/4) loam; common fine distinct pinkish gray (5YR 6/2) and

many fine prominent yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; friable; thin patchy clay films; about 5 percent pebbles by volume; mildly alkaline; clear smooth boundary.

B22t—17 to 28 inches; reddish brown (5YR 5/4) loam; common fine distinct pinkish gray (5YR 6/2) and many fine prominent yellowish red (5YR 5/8) mottles; moderate fine subangular blocky structure; friable; thin patchy clay films; about 5 percent pebbles by volume; mildly alkaline.

C—28 to 60 inches; reddish brown (5YR 5/4) loam; few fine distinct pinkish gray (5YR 6/2) and common fine distinct yellowish red (5YR 5/6) mottles; weak thick platy structure; friable; about 10 percent pebbles by volume; violent effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates typically range from 20 to 40 inches. The A1 or Ap horizon is dark brown, very dark grayish brown, or very dark brown. Where present, the A2 horizon is loam, sandy loam, or silt loam. Where present, the B1 horizon is loam, sandy loam, or silt loam. The Bt horizon is sandy loam, loam, or clay loam. Some pedons have a B3 horizon. The C horizon is loam or sandy loam. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Symco series

The Symco series consists of deep, somewhat poorly drained, moderately slowly permeable soils on till plains. The soils formed mostly in loamy calcareous till. Slope ranges from 0 to 3 percent.

Symco soils are similar to Lamartine and Solona soils and are commonly adjacent to Cathro, Hortonville, and Pella soils. Lamartine soils have a thicker solum and a thicker silty mantle. Solona soils have less clay in the subsoil. Cathro soils occupy lower landscape positions and are formed in 16 to 51 inches of organic deposits over loamy material. Hortonville soils occupy higher landscape positions and are well drained. Pella soils occupy lower landscape positions and are poorly drained.

Typical pedon of Symco silt loam, 0 to 3 percent slopes, approximately 1,000 feet west and 50 feet south of NE corner of section 11, T. 23 N., R. 24 E:

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

B21t—9 to 14 inches; brown (7.5YR 4/4) clay loam; common fine distinct grayish brown (10YR 5/2) and many fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin continuous clay films; about 5 percent pebbles by volume; mildly alkaline; clear wavy boundary.

B22t—14 to 24 inches; brown (7.5YR 4/4) clay loam; common fine distinct grayish brown (10YR 5/2) and many fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; thin continuous clay films; about 5 percent pebbles by volume; mildly alkaline; clear wavy boundary.

B23t—24 to 28 inches; reddish brown (5YR 4/4) clay loam; common fine distinct grayish brown (10YR 5/2) and many fine distinct yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; firm; about 5 percent pebbles by volume; slight effervescence; mildly alkaline; clear wavy boundary.

C—28 to 60 inches; reddish brown (5YR 5/4) loam; few fine distinct light brownish gray (10YR 6/2) and yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; friable; about 10 percent pebbles by volume; violent effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The A1 or Ap horizon is black, very dark brown, very dark grayish brown, or very dark gray. Where present, the A2 horizon is loam, sandy loam, or silt loam. The Bt horizon is dark brown, brown, light brown, reddish brown, or light reddish brown. It is loam, clay loam, or silty clay loam. Clay content averages between 20 and 40 percent. The C horizon is reddish brown, yellowish red, brown, or strong brown. It is loam, clay loam, or silty clay loam. The subsoil and substratum is mildly alkaline or moderately alkaline. Pebbles make up as much as 15 percent, by volume, of the solum and C horizon.

## Wainola series

The Wainola series consists of deep, somewhat poorly drained, rapidly permeable soils on lake plains, outwash plains, and lake beaches. They formed in water-laid sand. Slope ranges from 0 to 3 percent. These soils are more alkaline below a depth of about 2 feet and contain free carbonates at a shallower depth than is defined for the series, but these differences do not alter their behavior.

Wainola soils are commonly near Allendale, Casco, Matherton, Oakville, and Roscommon soils. Allendale soils are clayey in the lower part of the subsoil and in the substratum. Casco and Matherton soils have a loamy subsoil and are underlain by sand and gravel. Roscommon soils are poorly drained and very poorly drained. Casco and Oakville soils are well drained.

Typical pedon of Wainola loamy fine sand, 0 to 3 percent slopes, 2,600 feet west and 200 feet north of SE corner of section 8, T. 23 N., R. 24 E:

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, gray (10YR 6/1) dry; weak fine granular structure; very friable; strongly acid; clear irregular boundary.

A21—6 to 9 inches; dark grayish brown (10YR 4/2) loamy fine sand, gray (10YR 6/1) dry; weak fine subangular blocky structure; very friable; strongly acid; clear irregular boundary.

A22—9 to 13 inches; light gray (10YR 7/2) fine sand; weak fine subangular blocky structure; very friable; strongly acid; clear irregular boundary.
B21ir—13 to 16 inches; dark yellowish brown (10YR 3/4) fine sand; few fine distinct dark grayish brown (10YR 4/2) mottles; weak very fine subangular blocky structure; very friable; medium acid; clear irregular boundary.
B22ir—16 to 19 inches; yellowish brown (10YR 5/6) fine sand; few fine distinct strong brown (7.5YR 5/8) mottles and few fine prominent light brownish gray (10YR 6/2) mottles; massive; chunks of weakly cemented ortstein; friable; brittle dry; medium acid; clear irregular boundary.
B23ir—19 to 25 inches; yellowish brown (10YR 5/6) fine sand; few fine distinct strong brown (7.5YR 5/8) mottles and few fine prominent light brownish gray (10YR 6/2) mottles; massive; weakly cemented ortstein; friable; slightly acid; clear irregular boundary.
B3—25 to 29 inches; yellowish brown (10YR 5/4) fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; neutral; clear irregular boundary.
C—29 to 60 inches; grayish brown (10YR 5/2) fine sand; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 18 to 34 inches. The A1 or Ap horizon is black, very dark brown, very dark grayish brown, or dark grayish brown. Some pedons have no A2 horizon. The Bir horizons are dark brown, brown, very dark grayish brown, dark yellowish brown or yellowish brown. The darker colors are in the upper part of the horizon. In some pedons there are ortstein layers or fragments in the Bir horizon. The subsoil is strongly acid to neutral; the substratum is neutral or mildly alkaline.

## Wauseon series

The Wauseon series consists of deep, very poorly drained soils on lake plains and till plains. The soils are rapidly permeable in the upper part and very slowly permeable in the lower part. They formed in loamy lacustrine sediment over calcareous clay. Slope ranges from 0 to 2 percent.

Wauseon soils are commonly associated on the landscape with Allendale, Poygan, and Roscommon soils. Allendale soils are somewhat poorly drained. Poygan soils have clayey material in the subsoil. Roscommon soils are sandy throughout.

Typical pedon of Wauseon fine sandy loam, approximately 1,000 feet west and 2,560 feet south of NE corner of section 16, T. 25 N., R. 23 E:

Oa1—3 inches to 0; black (10YR 2/1) muck; weak fine granular structure; very friable; slightly acid; abrupt wavy boundary.
A1—0 to 12 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.
B2g—12 to 25 inches; gray (10YR 5/1) fine sandy loam; few fine prominent yellowish brown (10YR 5/6) and olive yellow (2.5Y 6/6) mottles; friable; neutral; clear wavy boundary.
IIC1—25 to 28 inches; dark grayish brown (10YR 4/2) clay; common medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; mildly alkaline; clear wavy boundary.
IIC2—28 to 60 inches; reddish brown (5YR 5/4) clay; massive; firm; violent effervescence; mildly alkaline.

The thickness of the solum and the depth to underlying calcareous clay range from 24 to 36 inches. The thickness of the mollic epipedon ranges from 10 to 18 inches. Some pedons have no muck surface layer. The A horizon is very dark grayish brown, very dark gray, very dark brown, or black. The B2 horizon has chroma of 1 or 2. It typically is fine sandy loam or very fine sandy loam but includes loamy fine sand. The IIC horizon is clay, silty clay, or less commonly, silty clay loam. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Waymor series

The Waymor series consists of deep, well drained, moderately permeable soils on till plains and moraines. The soils formed in thin loess and the underlying loamy, calcareous till. Slope commonly ranges from 1 to 20 percent, but is up to 35 percent in complex with other soils.

Waymor soils are similar to Hortonville soils and are commonly adjacent to Casco, Cathro, Lamartine, Pella, and Zurich soils. Hortonville soils have more clay in the lower part of the subsoil and in the substratum. Casco and Zurich soils occupy similar positions in the landscape. Casco soils are underlain by sand and gravel. Zurich soils are underlain by silt and very fine sand. Cathro soils occupy depressions and formed in 16 to 51 inches of organic deposits over loamy material. Lamartine soils occupy lower landscape positions and are somewhat poorly drained. Pella soils occupy lower landscape positions and are poorly drained.

Typical pedon of Waymor silt loam, 1 to 6 percent slopes, approximately 1,460 feet south and 30 feet east of NW corner of section 30, T. 22 N., R. 23 E:

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam; light gray (10YR 6/1) dry; moderate fine and very fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.
A21—7 to 10 inches; dark brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; weak fine and very fine subangular blocky structure; very friable; mildly alkaline; abrupt wavy boundary.

A22—10 to 15 inches; brown (10YR 5/3) silt loam; light gray (10YR 7/1) dry; weak medium platy structure parting to moderate very fine subangular blocky; very friable; mildly alkaline; clear irregular boundary.
B&A—15 to 22 inches; dark brown (7.5YR 4/4) silty clay loam (Bt); moderate medium subangular blocky structure; firm; brown (10YR 5/3) tongues of silt loam (A2), light gray (10YR 7/2) dry, 15 to 20mm wide that surround some peds (B21t) and occupies about 40 percent of the horizon; moderate very fine subangular blocky structure; friable; vesicular; mildly alkaline; clear irregular boundary.
B21t—22 to 28 inches; reddish brown (5YR 4/3) silty clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films; neutral; clear wavy boundary.
IIB22t—28 to 35 inches; reddish brown (5YR 4/3) clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films; about 5 percent pebbles by volume; mildly alkaline; clear wavy boundary.
IIB3—35 to 38 inches; reddish brown (5YR 4/4) loam; weak medium subangular blocky structure; firm; thin patchy clay films; about 5 percent pebbles by volume; mildly alkaline; clear wavy boundary.
IIC—38 to 60 inches; brown (7.5YR 4/4) loam; weak fine and medium subangular blocky structure; friable; about 10 percent pebbles by volume; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to free carbonates commonly corresponds to the thickness of the solum; however, in some places the lower part of the B horizon is calcareous. The loess mantle ranges from 10 to 30 inches in thickness. The Ap horizon is very dark gray, dark grayish brown, or very dark grayish brown. Where present, the A1 horizon is very dark brown, very dark grayish brown, or black and is less than 6 inches thick. Some pedons have no A2 horizon. The A&B horizon or B&A horizon has colors and characteristics of both the overlying A2 horizon and the underlying Bt horizon. The Bt and IIBt horizons are dark brown, reddish brown, or dark reddish brown. The Bt horizon is between 15 and 35 percent clay. The IIC horizon is brown or light brown loam or sandy loam. The subsoil is slightly acid to mildly alkaline; the substratum is mildly alkaline or moderately alkaline. Pebbles and cobbles make up 5 to 15 percent, by volume, of the IIB and IIC horizons.

### Zurich series

The Zurich series consists of deep, well drained soils on lake plains. The soils formed in silty material underlain by silty and sandy lacustrine sediment. Slope commonly ranges from 0 to 12 percent, but is up to 35 percent in complex with other soils.

Zurich soils are similar to Nichols soils and are commonly adjacent to Boyer, Casco, Hortonville, Kibbie, Kibbie Variant, and Waymor soils. Nichols soils do not have the silty clay loam subsoil of Zurich soils. Boyer and Casco soils are underlain by sand and gravel. Hortonville and Waymor soils formed partially in glacial till. Kibbie and Kibbie Variant soils are somewhat poorly drained and typically are lower in the landscape than Zurich soils. Kibbie Variant soils also have more clay in the upper part of the subsoil than Zurich soils.

Typical pedon of Zurich silt loam, from an area of Hortonville-Boyer-Zurich complex, 2 to 6 percent slopes, approximately 2,630 feet west and 900 feet north of SE corner of section 19, T. 23 N., R. 23 E:

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; many fibrous roots; neutral; abrupt smooth boundary.
B2t—7 to 16 inches; brown (7.5YR 4/4) silty clay loam; weak medium subangular blocky structure parting to moderate fine subangular blocky; grayish brown (10YR 5/2) patchy silt coatings; friable; thin patchy clay films; neutral; clear smooth boundary.
B3t—16 to 27 inches; brown (7.5YR 5/4) silt loam; weak fine subangular blocky structure; friable; thin patchy clay films; mildly alkaline; clear smooth boundary.
IIC1—27 to 35 inches; light brown (7.5YR 6/4) silt; weak fine and very thin platy structure; friable; violent effervescence; mildly alkaline; clear smooth boundary.
IIC2—35 to 60 inches; light brown (7.5YR 6/4) stratified silt and very fine sand; weak thin platy structure; friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 32 inches. Depth to carbonates is commonly the same as the thickness of the solum, but in some pedons it is as shallow as 16 inches. Most cultivated pedons have no A2 horizon and B1 horizon. The B horizon is brown, dark brown, strong brown, or dark yellowish brown. The C horizon is stratified with thin layers of silty clay loam in some pedons. The subsoil is neutral or mildly alkaline; the substratum is mildly alkaline or moderately alkaline.

## Formation of the soils

This section describes the factors of soil formation, relates them to the soils in the survey area, and explains the processes of soil formation.

### Soil-forming factors

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic forces. The characteristics of the soil at any given point are determined by (1) the *climate* under which the soil material has accumulated and existed since accumulation; (2) the *plant and animal life* on and in the soil; (3) the *relief,* or lay of the land; (4) the physical and mineralogical composition of the *parent material;* and (5) the length of

*time* the forces of soil formation have acted on the soil material. These five factors are closely interrelated, and few generalizations can be made about the effect of any one unless conditions are specified for the other four.

**Climate.** Climate affects soil formation both directly and indirectly through moisture (precipitation) and heat energy (temperature). The most important direct effect is on the weathering of rock and alteration of parent material. The indirect effects, however, are generally of equal or greater significance. For instance, as precipitation increases and the temperature rises, the clay content of the soil tends to increase. Climate also provides energy and a suitable environment for organisms. This is of special significance in the accumulation of organic matter and improvement of fertility.

A cool, humid climate is generally favorable for such plants as hardwood trees. Trees were the native vegetation in Kewaunee County. Soils that formed under forest vegetation have a lighter colored or thinner surface layer than soils formed under grass vegetation. Hortonville, Kewaunee, and Waymor soils are typical of soils formed under forest vegetation.

**Plant and animal life.** Plant and animal life contributes to soil formation chiefly through vegetative cover and organic matter accumulation. Bacteria, fungi, earthworms, rodents, and human civilization also are important contributors to soil formation or alteration. Two chief effects of plant and animal life on soil formation are increased organic matter content and movement of plant nutrients in plant roots from lower to upper horizons. Soil structure and porosity are also partly the result of plant and animal life.

In places, civilization has significantly altered or even destroyed many soil properties. On some soils, long-time cultivation has resulted in erosion, liming, fertilization, and changes in plant cover. Examples are eroded areas of Kewaunee and Hortonville soils. Other soils, such as Udorthents, have been moved or mixed during the construction of buildings and roads.

**Relief.** Relief influences soil formation by controlling drainage, runoff, erosion, and other actions of water. Relative elevations or inequalities of the land surface of a given type of parent material often can be related closely to drainage, thickness, and organic matter content of the A horizon; thickness of the solum; and differentiation of horizons in the soils.

The topography of Kewaunee County ranges from nearly level, dotted with small depressions, to steep. In depressional areas, runoff is slow and internal drainage generally is slow. Soils in depressions remain wet and cool. As a result, they develop mottling throughout their profiles and, because decomposition of surface litter is slow, they develop a thick, dark surface layer that is high in organic matter content. Examples of such soils are those of the Symco, Pella, and Poygan series.

On steep areas, runoff is more rapid and less water enters the soil. As a result, the soils are not as mature and have less clay in the subsoil and a thinner solum. Erosion in some places has removed the upper horizons and altered the physical nature of the soils. Some of the soils on steep slopes are Hortonville, Kewaunee, and Waymor.

**Parent material.** Parent material affects the kind of soil profile that develops and determines it almost entirely in some places. The nature of the parent material has much to do with the texture, mineral composition, and chemical properties of the soil formed in it.

The parent material of most soils in Kewaunee County was deposited by glaciers or by melt water when the glaciers receded. The parent material of some of the soils along streams, however, is recent alluvium. The parent material of organic soils consists of plant remains that were accumulated and preserved under water in swamps or shallow lakes.

Parent material deposited by the Cary-age glacial substage occupies a north-south belt across the central part of the county. These deposits are mainly loam and sandy loam till, outwash sand and gravel, and some small areas of silt and very fine sand lacustrine sediment. Cary-age parent material is typically calcareous and is brown or yellowish brown. Lamartine and Waymor are examples of soils formed in Cary-age till. Casco, Dresden, and Rodman soils formed in Cary-age outwash; Zurich soils formed in lacustrine sediment. Segments of the hilly kettle moraine are also associated with Cary-age parent material.

The parent material deposited by the more recent Valderan substage occupies the western edge and eastern portions of the county. These deposits are mainly calcareous, reddish brown loam to clay till. Geologists correlate this parent material with the buried Two Creeks forest bed in northeastern Manitowoc County (*5*). Hortonville, Kewaunee, Manawa, and Poygan are examples of soils formed in the Valders Formation parent material.

**Time.** Time is needed for the changing of parent material into a soil. It may be much or little, but time is always required for horizon differentiation. Soils can have a profile that is strongly developed, a profile that is weakly developed, or a profile that is somewhere in-between, depending on the length of time the soil-forming factors have been active. The Hortonville and Kewaunee soils, for example, have moderately distinct horizons and are considered fairly mature. On the other hand, soils formed in recently deposited alluvium, such as Fluvaquents, show little or no profile development.

## Horizon differentiation

Differentiation of horizons in the soils of Kewaunee County is the result of one or more of the following: accumulation of organic matter, leaching of carbonates

and salts, translocation of silicate clay minerals, and reduction and transfer of iron.

Enough organic matter to form an A1 horizon has accumulated in the uppermost layers of all but a few soils in the county. The amount varies. The Oakville soils, for example, have less organic matter and a thinner A1 horizon than the Dresden, Hortonville, Kewaunee, and Waymor soils. Much of the organic matter is humus.

Leaching of carbonates and salts has occurred in almost all of the soils. Its visible effect on horizon differentiation has been limited, but it has indirectly facilitated the translocation of silicate clay minerals in some soils. Free carbonates and salts have been almost completely carried out of the solum of some of the well drained soils. Even in the wettest soils, through which water moves very slowly, some leaching is indicated by a lack of free carbonates in the upper part of the solum.

The translocation of silicate clay minerals has contributed to the development of horizons in many soils. In Dresden, Hortonville, Kewaunee, Waymor, and other deep soils, silicate clay has accumulated in an illuvial B horizon that contains more total clay and more fine clay than the horizons above or below it. In Oakville and other soils, however, the illuvial horizon contains no more clay than the underlying C horizon. Nearly all soils that have a blocky structure contain clay films, some of which are thin and weakly expressed. The films occur as thin layers on ped faces, and the long axes of the clay particles lie parallel to the surface on which they are deposited. This translocated clay, where strongly expressed, fills small cracks in the soil and coats the sides of crevices and openings left by plant roots, animals, and insects. The horizon from which clay has been carried is identified in these soils by its bleached appearance, friable consistence, and generally platy structure.

Nearly structureless soils, as those of the Shiocton series, have a slight accumulation of silicate clay in the B horizon. They do not have clay films on ped surfaces, however, because they have no peds with prominent cleavage planes, nor have they been subjected to intensive or prolonged weathering. The clay in the illuvial horizon of these soils generally is a coating on individual sand or silt grains parallel to the surface of the grain. A few pores in this horizon have been filled with weak, discontinuous, clay films.

The reduction and transfer of iron oxides has occurred in all the mineral soils that are very poorly drained, poorly drained, and somewhat poorly drained. This process, called gleying, is most pronounced in the Pella and Poygan soils. It is indicated by a gray color in the subsurface layers. After iron has been reduced, it can be removed completely from the soil profile. In Kewaunee County, it has commonly moved only a short distance and stopped either in the horizon of its origin or in an adjoining horizon. Segregated iron forms yellowish red, strong brown, or yellowish brown mottles. Black manganese spots are also common.

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## Glossary

**AC soil.** A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim.** 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 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 |

**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.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

**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 coat, clay skin.

**Coarse fragments.** Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

**Coarse textured (light textured) soil.** Sand or loamy sand.

**Cobblestone (or cobble).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

**Complex slope.** Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

**Complex, soil.** A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

**Compressible.** Excessive decrease in volume of soft soil under load.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conservation tillage.** Tillage operations limited in number to those properly timed and essential to produce a crop.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping (or contour farming).** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

**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.** Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

**Deferred grazing.** A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

**Depth to rock.** Bedrock at a depth that adversely affects the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage

outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Drumlin.** A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Erosion.** The wearing away of the land surface by running 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 a bare surface.

**Esker** (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

**Excess fines.** Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

**Fast intake.** The rapid movement of water into the soil.

**Favorable.** Favorable soil features for the specified use.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fine textured (heavy textured) soil.** Sandy clay, silty clay, and clay.

**Flooding.** The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forage.** Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

**Frost action.** Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Glacial drift** (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the assorted and unassorted material deposited by streams flowing from glaciers.

**Glacial outwash** (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

**Glacial till** (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

**Glaciofluvial deposits** (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

**Glaciolacustrine deposits.** Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. Many are interbedded or laminated.

**Gleyed soil.** A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

**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 from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Habitat.** The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

**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. The major horizons of mineral soil are as follows:

*O horizon.*—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

*A horizon.*—The mineral horizon, formed or forming 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.

*A2 horizon.*—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks 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 from which the solum is presumed to have 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.

**Hummocky.** Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

**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.

**Kame** (geology). An irregular, short ridge or hill of stratified glacial drift.

**Lacustrine deposit** (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Light textured soil.** Sand and loamy sand.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low strength.** Inadequate strength for supporting 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 greater than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous areas.** Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

**Moraine** (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Muck.** Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

**Munsell notation.** A designation of color by degrees of the three single 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.

**Nutrient, plant.** Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

**Organic matter.** A general term for plant and animal material in all stages of decomposition. The content of organic matter in, or on, a soil is expressed as—

| | *Percent* |
|---|---|
| Very low | Less than 0.5 |
| Low | 0.5 to 1.0 |
| Moderately low | 1.0 to 2.0 |
| Moderate | 2.0 to 4.0 |
| High | 4.0 to 8.0 |
| Very high | More than 8.0 |

**Outwash, glacial.** Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

**Outwash plain.** A land form 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 great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

**Peat.** Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

**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.** The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the 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 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

**Phase, soil.** A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

**pH value.** (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

**Piping.** Moving water of subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state.

**Poorly graded.** Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Poor outlets.** Surface or subsurface drainage outlets difficult or expensive to install.

**Productivity** (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

| | *pH* |
|---|---|
| Extremely acid | Below 4.5 |
| Very strongly acid | 4.5 to 5.0 |
| Strongly acid | 5.1 to 5.5 |
| Medium acid | 5.6 to 6.0 |
| Slightly acid | 6.1 to 6.5 |
| Neutral | 6.6 to 7.3 |
| Mildly alkaline | 7.4 to 7.8 |
| Moderately alkaline | 7.9 to 8.4 |
| Strongly alkaline | 8.5 to 9.0 |
| Very strongly alkaline | 9.1 and higher |

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth.** Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Runoff.** The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

**Seepage.** The rapid movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

**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. Soils are described in terms that indicate the range in slope gradient—

| | *Percent* |
|---|---|
| Nearly level | 0 to 2 |
| Gently sloping | 2 to 6 |
| Sloping | 6 to 12 |
| Moderately steep | 12 to 20 |
| Steep | 20 to 30 |
| Very steep | more than 30 |

**Slow intake.** The slow movement of water into the soil.

**Slow refill.** The slow filling of ponds, resulting from restricted permeability in the soil.

**Small stones.** Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

**Soil.** A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature 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 other plant and animal life characteristics of the soil are largely confined to the solum.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

**Stratified.** Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining 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.** Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

**Terminal moraine.** A belt of thick glacial drift that generally marks the termination of important glacial advances.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer.** Otherwise suitable soil material too thin for the specified use.

**Till plain.** An extensive flat to undulating area underlain by glacial till.

**Tilth, soil.** The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Topsoil** (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

**Trace elements.** The chemical elements in soils, in only extremely small amounts, essential to plant growth. Examples are zinc, cobalt, manganese, copper, and iron.

**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 the limited geographic soil area does not justify creation of a new series.

**Water table.** The upper limit of the soil or underlying rock material that is wholly saturated with water.
*Water table, apparent.* A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.
*Water table, artesian.* A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.
*Water table, perched.* A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

# TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

[All data from Kewaunee, Wisconsin, based on records from 1930 to 1959]

| Month | Temperature | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Two years in 10 will have monthly average | | | One year in 10 will have monthly total | | | |
| | Average daily maximum | Average daily minimum | Equal to or higher than | Equal to or lower than | Average | Less than | More than | Average number of days with 0.10 inch or more | Average snowfall |
| | °F | °F | °F | °F | In | In | In | | In |
| January | 28.2 | 12.4 | 25 | 16 | 1.35 | 0.34 | 2.28 | 4 | 11.9 |
| February | 30.1 | 13.5 | 25 | 19 | 1.32 | 0.31 | 3.20 | 4 | 12.1 |
| March | 38.3 | 23.3 | 33 | 28 | 1.64 | 0.59 | 3.10 | 4 | 7.3 |
| April | 50.4 | 33.8 | 45 | 40 | 2.42 | 0.79 | 4.14 | 5 | 1.4 |
| May | 61.2 | 42.5 | 54 | 50 | 2.50 | 1.01 | 4.17 | 6 | 0.2 |
| June | 71.5 | 51.8 | 63 | 59 | 3.17 | 1.26 | 5.49 | 6 | 0.0 |
| July | 78.4 | 58.9 | 71 | 66 | 2.94 | 1.41 | 4.92 | 5 | 0.0 |
| August | 77.8 | 59.1 | 70 | 70 | 2.76 | 0.97 | 4.72 | 5 | 0.0 |
| September | 69.6 | 51.4 | 61 | 59 | 2.96 | 0.83 | 5.67 | 5 | 0.0 |
| October | 58.5 | 41.5 | 52 | 47 | 1.76 | 0.47 | 3.61 | 4 | 0.1 |
| November | 43.2 | 28.9 | 40 | 33 | 2.23 | 0.54 | 4.49 | 5 | 2.5 |
| December | 32.0 | 17.9 | 28 | 22 | 1.48 | 0.37 | 2.35 | 4 | 9.7 |

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[All data from Kewaunee, Wisconsin, based on records from 1930 to 1959]

| Probability | Temperature | | | | |
|---|---|---|---|---|---|
| | 16° F or lower | 20° F or lower | 24° F or lower | 28° F or lower | 32° F or lower |
| Spring: | | | | | |
| 2 years in 10 later than-- | Apr. 1 | Apr. 8 | Apr. 18 | Apr. 28 | May 14 |
| 4 years in 10 later than-- | Mar. 24 | Mar. 31 | Apr. 10 | Apr. 21 | May 7 |
| 6 years in 10 later than-- | Mar. 18 | Mar. 25 | Apr. 4 | Apr. 15 | May 1 |
| 8 years in 10 later than-- | Mar. 10 | Mar. 17 | Mar. 27 | Apr. 8 | Apr. 24 |
| Fall: | | | | | |
| 2 years in 10 earlier than- | Nov. 14 | Nov. 6 | Oct. 26 | Oct. 15 | Oct. 1 |
| 4 years in 10 earlier than- | Nov. 22 | Nov. 14 | Nov. 3 | Oct. 23 | Oct. 9 |
| 6 years in 10 earlier than- | Nov. 28 | Nov. 20 | Nov. 9 | Oct. 29 | Oct. 15 |
| 8 years in 10 earlier than- | Dec. 6 | Nov. 28 | Nov. 17 | Nov. 6 | Oct. 22 |

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

| Map symbol | Soil name | Acres | Percent |
|---|---|---|---|
| AdA | Allendale loamy fine sand, 0 to 3 percent slopes | 450 | 0.2 |
| Ax | Angelica silt loam | 1,500 | 0.7 |
| Ba | Bach silt loam | 1,285 | 0.6 |
| Bn | Bonduel loam | 1,320 | 0.6 |
| Bo | Borosaprists | 335 | 0.2 |
| BrB | Boyer loamy sand, 1 to 6 percent slopes | 1,400 | 0.7 |
| BrC | Boyer loamy sand, 6 to 12 percent slopes | 445 | 0.2 |
| BrE | Boyer loamy sand, 20 to 35 percent slopes | 285 | 0.1 |
| Ca | Carbondale muck | 10,665 | 5.0 |
| CbA | Casco sandy loam, 0 to 2 percent slopes | 385 | 0.2 |
| CbB | Casco sandy loam, 2 to 6 percent slopes | 5,990 | 2.8 |
| CbC2 | Casco sandy loam, 6 to 12 percent slopes, eroded | 1,610 | 0.8 |
| CdB | Casco-Rodman complex, 2 to 6 percent slopes | 350 | 0.2 |
| CdC2 | Casco-Rodman complex, 6 to 12 percent slopes, eroded | 435 | 0.2 |
| CdD2 | Casco-Rodman complex, 12 to 20 percent slopes, eroded | 880 | 0.4 |
| Cm | Cathro muck | 5,745 | 2.7 |
| DrA | Dresden silt loam, 0 to 2 percent slopes | 610 | 0.3 |
| DrB | Dresden silt loam, 2 to 6 percent slopes | 770 | 0.4 |
| FaA | Fabius loam, 0 to 3 percent slopes | 2,085 | 1.0 |
| Fu | Fluvaquents | 2,550 | 1.2 |
| HrB | Hortonville silt loam, 1 to 6 percent slopes | 28,430 | 13.5 |
| HrC2 | Hortonville silt loam, 6 to 12 percent slopes, eroded | 9,285 | 4.4 |
| HrD2 | Hortonville silt loam, 12 to 20 percent slopes, eroded | 2,715 | 1.3 |
| HsB | Hortonville-Symco silt loams, 1 to 6 percent slopes | 8,720 | 4.1 |
| HzB | Hortonville-Boyer-Zurich complex, 2 to 6 percent slopes | 2,080 | 1.0 |
| HzC2 | Hortonville-Boyer-Zurich complex, 6 to 12 percent slopes, eroded | 2,135 | 1.0 |
| HzD2 | Hortonville-Boyer-Zurich complex, 12 to 20 percent slopes, eroded | 1,630 | 0.8 |
| HzE | Hortonville-Boyer-Zurich complex, 20 to 35 percent slopes | 3,000 | 1.4 |
| KhB | Kewaunee silt loam, 2 to 6 percent slopes | 9,270 | 4.4 |
| KpB2 | Kewaunee silty clay loam, 2 to 6 percent slopes, eroded | 6,385 | 3.0 |
| KpC2 | Kewaunee silty clay loam, 6 to 12 percent slopes, eroded | 3,870 | 1.8 |
| KpD2 | Kewaunee silty clay loam, 12 to 20 percent slopes, eroded | 680 | 0.3 |
| KsC3 | Kewaunee silty clay, 6 to 12 percent slopes, severely eroded | 525 | 0.2 |
| KsD3 | Kewaunee silty clay, 12 to 20 percent slopes, severely eroded | 715 | 0.3 |
| KsE3 | Kewaunee silty clay, 20 to 35 percent slopes, severely eroded | 590 | 0.3 |
| KtB | Kewaunee-Manawa silt loams, 1 to 6 percent slopes | 2,555 | 1.2 |
| KuA | Kibbie silt loam, 0 to 3 percent slopes | 675 | 0.3 |
| KvA | Kibbie Variant silt loam, 0 to 3 percent slopes | 345 | 0.2 |
| KwB | Kolberg silt loam, 1 to 6 percent slopes | 3,250 | 1.5 |
| KwC2 | Kolberg silt loam, 6 to 12 percent slopes, eroded | 685 | 0.3 |
| KxB | Kolberg Variant silt loam, 1 to 6 percent slopes | 1,515 | 0.7 |
| LmA | Lamartine silt loam, 0 to 3 percent slopes | 2,740 | 1.3 |
| LoB | Longrie loam, 2 to 6 percent slopes | 1,090 | 0.5 |
| McA | Manawa silt loam, 0 to 3 percent slopes | 6,040 | 2.9 |
| MeB | Manistee loamy fine sand, 2 to 6 percent slopes | 360 | 0.2 |
| Mk | Markey muck | 2,645 | 1.2 |
| MmA | Matherton silt loam, 0 to 3 percent slopes | 1,715 | 0.8 |
| MrB | Menominee loamy fine sand, loamy substratum, 1 to 6 percent slopes | 635 | 0.3 |
| MsB | Menominee Variant loamy fine sand, 1 to 6 percent slopes | 950 | 0.4 |
| MtA | Mosel loam, 0 to 3 percent slopes | 970 | 0.5 |
| My | Mussey loam | 1,670 | 0.8 |
| NaB | Namur loam, 1 to 6 percent slopes | 705 | 0.3 |
| NrD | Namur-Rock outcrop complex, 6 to 20 percent slopes | 1,035 | 0.5 |
| NxB | Nichols fine sandy loam, 1 to 6 percent slopes | 315 | 0.1 |
| OaB | Oakville loamy fine sand, 1 to 6 percent slopes | 1,065 | 0.5 |
| OaC | Oakville loamy fine sand, 6 to 12 percent slopes | 385 | 0.2 |
| OdB | Omro silt loam, 1 to 6 percent slopes | 2,675 | 1.3 |
| OeC2 | Omro silty clay loam, 6 to 12 percent slopes, eroded | 345 | 0.2 |
| OhB | Onaway loam, 1 to 6 percent slopes | 6,450 | 3.1 |
| OhC2 | Onaway loam, 6 to 12 percent slopes, eroded | 950 | 0.4 |
| Pe | Pella silt loam | 5,390 | 2.6 |
| Pg | Pits, gravel | 795 | 0.4 |
| Po | Poygan silty clay loam | 1,800 | 0.9 |
| RcE | Rodman-Casco complex, 20 to 35 percent slopes | 605 | 0.3 |
| Rs | Roscommon mucky loamy sand | 1,030 | 0.5 |
| Ru | Ruse loam | 810 | 0.4 |
| ShA | Shiocton silt loam, 0 to 3 percent slopes | 1,015 | 0.5 |
| SoA | Solona silt loam, 0 to 3 percent slopes | 4,065 | 1.9 |
| SyA | Symco silt loam, 0 to 3 percent slopes | 12,085 | 5.7 |
| Uf | Udifluvents | 1,020 | 0.5 |
| UoB | Udorthents, 0 to 6 percent slopes | 530 | 0.3 |
| UoF | Udorthents, 25 to 50 percent slopes | 800 | 0.4 |

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

| Map symbol | Soil name | Acres | Percent |
|---|---|---|---|
| WaA | Wainola loamy fine sand, 0 to 3 percent slopes | 1,365 | 0.6 |
| We | Wauseon fine sandy loam | 765 | 0.4 |
| WoB | Waymor silt loam, 1 to 6 percent slopes | 8,540 | 4.0 |
| WoC2 | Waymor silt loam, 6 to 12 percent slopes, eroded | 3,305 | 1.6 |
| WoD2 | Waymor silt loam, 12 to 20 percent slopes, eroded | 905 | 0.4 |
| WzB | Waymor-Casco-Zurich complex, 1 to 6 percent slopes | 690 | 0.3 |
| WzC2 | Waymor-Casco-Zurich complex, 6 to 12 percent slopes, eroded | 1,055 | 0.5 |
| WzD | Waymor-Casco-Zurich complex, 12 to 20 percent slopes | 920 | 0.4 |
| WzE | Waymor-Casco-Zurich complex, 20 to 35 percent slopes | 625 | 0.3 |
| ZuA | Zurich silt loam, 0 to 2 percent slopes | 185 | 0.1 |
| ZuB | Zurich silt loam, 2 to 6 percent slopes | 565 | 0.3 |
| ZuC2 | Zurich silt loam, 6 to 12 percent slopes, eroded | 240 | 0.1 |
| | Water areas <40 acres | 317 | 0.2 |
| | Water areas >40 acres | 760 | 0.4 |
| | Total | 211,072 | 100.0 |

TABLE 4.--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 | Corn silage | Oats | Grass-legume hay | Kentucky bluegrass |
|---|---|---|---|---|---|
| | Bu | Ton | Bu | Ton | AUM* |
| AdA---- Allendale | 70 | 12 | 65 | 3.5 | 3.0 |
| Ax---- Angelica | 105 | 18 | 75 | 4.0 | 4.0 |
| Ba---- Bach | 100 | 18 | 70 | 4.0 | 4.0 |
| Bn---- Bonduel | 80 | 12 | 75 | 4.0 | 4.0 |
| Bo**. Borosaprists | | | | | |
| BrB---- Boyer | 70 | 12 | 60 | 3.0 | 2.5 |
| BrC---- Boyer | 65 | 11 | 50 | 2.5 | 2.0 |
| BrE---- Boyer | --- | --- | --- | 2.0 | 1.5 |
| Ca---- Carbondale | --- | 15 | 65 | 3.0 | 4.0 |
| CbA---- Casco | 85 | 14 | 70 | 4.0 | 3.0 |
| CbB---- Casco | 80 | 13 | 65 | 4.0 | 3.0 |
| CbC2---- Casco | 75 | 12 | 60 | 3.5 | 2.5 |
| CdB---- Casco-Rodman | 10 | 10 | 55 | 3.0 | 2.0 |
| CdC2---- Casco-Rodman | 55 | 9 | 50 | 2.5 | 2.0 |
| CdD2---- Casco-Rodman | --- | --- | --- | 2.0 | 1.5 |
| Cm---- Cathro | 80 | 12 | 65 | 2.5 | 4.0 |
| DrA---- Dresden | 100 | 18 | 75 | 4.5 | 4.0 |
| DrB---- Dresden | 95 | 17 | 75 | 4.5 | 4.0 |
| FaA---- Fabius | 75 | 12 | 60 | 4.0 | 3.5 |
| Fu**. Fluvaquents | | | | | |
| HrB---- Hortonville | 105 | 18 | 80 | 5.0 | 4.0 |

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

| Soil name and map symbol | Corn | Corn silage | Oats | Grass-legume hay | Kentucky bluegrass |
|---|---|---|---|---|---|
| | Bu | Ton | Bu | Ton | AUM* |
| HrC2---------- Hortonville | 95 | 16 | 75 | 5.0 | 4.0 |
| HrD2---------- Hortonville | 85 | 14 | 65 | 4.0 | 3.5 |
| HsB---------- Hortonville-Symco | 100 | 17 | 80 | 5.5 | 4.5 |
| HzB---------- Hortonville-Boyer-Zurich | 100 | 17 | 75 | 5.0 | 4.0 |
| HzC2---------- Hortonville-Boyer-Zurich | 95 | 16 | 70 | 4.5 | 4.0 |
| HzD2---------- Hortonville-Boyer-Zurich | 85 | 14 | 65 | 4.0 | 3.5 |
| HzE---------- Hortonville-Boyer-Zurich | --- | --- | --- | 3.5 | 3.0 |
| KhB---------- Kewaunee | 110 | 18 | 80 | 5.0 | 4.0 |
| KpB2---------- Kewaunee | 100 | 17 | 75 | 5.0 | 4.0 |
| KpC2---------- Kewaunee | 90 | 15 | 70 | 4.5 | 3.5 |
| KpD2---------- Kewaunee | 85 | 14 | 60 | 4.0 | 3.0 |
| KsC3---------- Kewaunee | 75 | 12 | 60 | 3.5 | 3.3 |
| KsD3---------- Kewaunee | --- | --- | 40 | 3.2 | 3.0 |
| KsE3---------- Kewaunee | --- | --- | --- | 2.7 | 2.5 |
| KtB---------- Kewaunee-Manawa | 110 | 18 | 77 | 5.1 | 4.2 |
| KuA---------- Kibbie | 110 | 18 | 80 | 4.5 | 4.0 |
| KvA---------- Kibbie Variant | 110 | 18 | 70 | 4.5 | 4.0 |
| KwB---------- Kolberg | 85 | 13 | 75 | 4.5 | 4.0 |
| KwC2---------- Kolberg | 80 | 12 | 70 | 4.0 | 4.0 |
| KxB---------- Kolberg Variant | 70 | 11 | 65 | 3.2 | 2.3 |
| LmA---------- Lamartine | 115 | 18 | 80 | 5.0 | 4.3 |
| LoB---------- Longrie | 75 | 11 | 70 | 3.5 | 3.0 |
| McA---------- Manawa | 110 | 18 | 75 | 5.0 | 4.5 |
| MeB---------- Manistee | 70 | 12 | 60 | 3.5 | 3.0 |

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

| Soil name and map symbol | Corn | Corn silage | Oats | Grass-legume hay | Kentucky bluegrass |
|---|---|---|---|---|---|
| | Bu | Ton | Bu | Ton | AUM* |
| Mk---------- Markey | 50 | 12 | 70 | 3.0 | 3.0 |
| MmA---------- Matherton | 100 | 17 | 80 | 4.5 | 4.0 |
| MrB---------- Menominee | 70 | 12 | 65 | 4.0 | 3.0 |
| MsB---------- Menominee Variant | 65 | 10 | 60 | 3.5 | 2.5 |
| MtA---------- Mosel | 115 | 19 | 75 | 5.0 | 4.7 |
| My---------- Mussey | 95 | 15 | 70 | 3.4 | 3.5 |
| NaB---------- Namur | --- | 6 | 45 | 2.0 | 2.1 |
| NrD---------- Namur-Rock outcrop | --- | --- | --- | --- | 1.5 |
| NxB---------- Nichols | 100 | 18 | 75 | 5.0 | 4.0 |
| OaB---------- Oakville | 50 | 8 | 48 | 2.5 | 2.0 |
| OaC---------- Oakville | --- | --- | 35 | 2.0 | 1.5 |
| OdB---------- Omro | 100 | 17 | 70 | 5.0 | 4.3 |
| OeC2---------- Omro | 90 | 16 | 70 | 5.0 | 4.0 |
| OhB---------- Onaway | 105 | 18 | 75 | 4.5 | 4.0 |
| OhC2---------- Onaway | 80 | 14 | 65 | 4.0 | 3.5 |
| Pe---------- Pella | 110 | 18 | 75 | 4.8 | 4.0 |
| Pg**. Pits | | | | | |
| Po---------- Poygan | 110 | 18 | 75 | 5.0 | 4.5 |
| RcE---------- Rodman-Casco | --- | --- | --- | --- | 1.0 |
| Rs---------- Roscommon | --- | --- | --- | --- | 2.5 |
| Ru---------- Ruse | --- | --- | 65 | 3.0 | 3.0 |
| ShA---------- Shiocton | 85 | 14 | 75 | 4.5 | 4.0 |
| SoA---------- Solona | 105 | 18 | 75 | 4.5 | 4.2 |

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

| Soil name and map symbol | Corn | Corn silage | Oats | Grass-legume hay | Kentucky bluegrass |
|---|---|---|---|---|---|
| | Bu | Ton | Bu | Ton | AUM* |
| SyA---------- Symco | 100 | 16 | 75 | 5.0 | 4.5 |
| Uf**. Udifluvents | | | | | |
| UoB**, UoF**. Udorthents | | | | | |
| WaA---------- Wainola | 65 | 11 | 65 | 3.5 | 3.0 |
| We---------- Wauseon | 80 | 12 | 70 | 3.5 | 3.0 |
| WoB---------- Waymor | 115 | 18 | 75 | 4.5 | 3.7 |
| WoC2---------- Waymor | 95 | 15 | 60 | 4.0 | 3.5 |
| WoD2---------- Waymor | 85 | 13 | 50 | 3.5 | 3.0 |
| WzB---------- Waymor-Casco-Zurich | 96 | 15 | 70 | 4.3 | 3.5 |
| WzC2---------- Waymor-Casco-Zurich | 92 | 14 | 60 | 3.9 | 3.2 |
| WzD---------- Waymor-Casco-Zurich | --- | --- | --- | 3.5 | 3.0 |
| WzE---------- Waymor-Casco-Zurich | --- | --- | --- | 3.0 | 2.7 |
| ZuA---------- Zurich | 105 | 17 | 75 | 5.0 | 4.2 |
| ZuB---------- Zurich | 100 | 16 | 70 | 4.5 | 4.0 |
| ZuC2---------- Zurich | 90 | 14 | 65 | 4.1 | 3.5 |

* 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 5.--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 | 185 | --- | --- | --- |
| II | 127,730 | 82,420 | 42,700 | 610 |
| III | 42,055 | 30,530 | 8,790 | 2,735 |
| IV | 26,475 | 9,705 | 15,705 | 1,065 |
| V | --- | --- | --- | --- |
| VI | 6,595 | 5,505 | --- | 1,090 |
| VII | 2,230 | 590 | --- | 1,640 |
| VIII | --- | --- | --- | --- |

TABLE 6.--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 | |
| AdA---------- Allendale | 3o | Slight | Slight | Severe | Slight | Quaking aspen------- | 60 | White spruce, balsam fir, white ash, red maple. |
| | | | | | | White ash---------- | --- | |
| | | | | | | Swamp white oak----- | --- | |
| | | | | | | White spruce-------- | --- | |
| | | | | | | Paper birch--------- | --- | |
| | | | | | | Balsam fir---------- | --- | |
| Ax---------- Angelica | 4w | Slight | Severe | Severe | Severe | Balsam fir---------- | 45 | |
| | | | | | | Quaking aspen------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | Red maple---------- | --- | |
| | | | | | | Northern white-cedar | --- | |
| | | | | | | Black ash---------- | --- | |
| Ba---------- Bach | 2w | Slight | Severe | Severe | Severe | Silver maple-------- | 91 | Northern white-cedar, eastern white pine, red maple, white spruce. |
| | | | | | | Red maple---------- | 66 | |
| | | | | | | Bur oak------------ | 66 | |
| | | | | | | White ash---------- | 66 | |
| | | | | | | Black ash---------- | --- | |
| | | | | | | Swamp white oak----- | 66 | |
| Bn---------- Bonduel | 3o | Slight | Slight | Slight | Slight | Northern white-cedar | 35 | Poplar, white spruce. |
| | | | | | | Quaking aspen------- | --- | |
| | | | | | | Paper birch--------- | --- | |
| BrB, BrC---------- Boyer | 3s | Slight | Slight | Moderate | Slight | Northern red oak---- | 60 | Eastern white pine, red pine. |
| | | | | | | White oak---------- | --- | |
| | | | | | | Black oak---------- | --- | |
| | | | | | | Northern pin oak---- | --- | |
| BrE---------- Boyer | 3s | Moderate | Moderate | Moderate | Slight | Northern red oak---- | 60 | Eastern white pine, red pine. |
| | | | | | | White oak---------- | --- | |
| | | | | | | Black oak---------- | --- | |
| | | | | | | Northern pin oak---- | --- | |
| Ca---------- Carbondale | 3w | Slight | Severe | Severe | Severe | Northern white-cedar | 34 | |
| | | | | | | Balsam fir---------- | --- | |
| | | | | | | Black spruce-------- | --- | |
| | | | | | | Tamarack----------- | --- | |
| CbA, CbB, CbC2----- Casco | 3s | Slight | Slight | Moderate | Slight | Northern red oak---- | 55 | Red pine, eastern redcedar, eastern white pine. |
| | | | | | | Black oak---------- | --- | |
| | | | | | | White oak---------- | --- | |
| CdB*, CdC2*: | | | | | | | | |
| Casco---------- | 3s | Slight | Slight | Moderate | Slight | Northern red oak---- | 55 | Red pine, eastern redcedar, eastern white pine. |
| | | | | | | Black oak---------- | --- | |
| | | | | | | White oak---------- | --- | |
| Rodman---------- | 4f | Slight | Slight | Severe | Slight | Northern red oak---- | 45 | Red pine, eastern white pine, eastern redcedar. |
| | | | | | | White oak---------- | --- | |
| | | | | | | Red pine----------- | --- | |
| CdD2*: | | | | | | | | |
| Casco---------- | 3s | Moderate | Moderate | Moderate | Slight | Northern red oak---- | 55 | Red pine, eastern redcedar, eastern white pine. |
| | | | | | | Black oak---------- | --- | |
| | | | | | | White oak---------- | --- | |
| Rodman---------- | 4f | Moderate | Moderate | Severe | Slight | Northern red oak---- | 45 | Red pine, eastern white pine, eastern redcedar. |
| | | | | | | White oak---------- | --- | |
| | | | | | | Red pine----------- | --- | |

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| 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 | |
| Cm----------<br>Cathro | 3w | Slight | Severe | Severe | Severe | Northern white-cedar<br>Balsam fir----------<br>Tamarack----------<br>American basswood---<br>Red maple----------<br>Black spruce-------- | 37<br>---<br>---<br>---<br>---<br>--- | |
| DrA, DrB----------<br>Dresden | 2o | Slight | Slight | Slight | Slight | Northern red oak----<br>Bur oak----------<br>Black oak----------<br>White oak----------<br>Northern pin oak----<br>Black cherry--------<br>Shagbark hickory---- | 70<br>---<br>---<br>---<br>---<br>---<br>--- | Red pine, eastern white pine, white spruce, Norway spruce. |
| FaA----------<br>Fabius | 3o | Slight | Slight | Slight | Slight | Quaking aspen-------<br>White ash----------<br>Northern red oak----<br>Red maple---------- | 60<br>---<br>---<br>--- | White spruce, Norway spruce, eastern white pine, northern white-cedar. |
| HrB, HrC2----------<br>Hortonville | 1o | Slight | Slight | Slight | Slight | Sugar maple---------<br>Northern red oak----<br>American basswood--- | 66<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| HrD2----------<br>Hortonville | 1r | Moderate | Moderate | Slight | Slight | Sugar maple---------<br>Northern red oak----<br>American basswood--- | 66<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| HsB*:<br>Hortonville------- | 1o | Slight | Slight | Slight | Slight | Sugar maple---------<br>Northern red oak----<br>American basswood--- | 66<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| Symco---------- | 1o | Slight | Slight | Slight | Slight | Northern red oak----<br>Red maple----------<br>White ash----------<br>American basswood---<br>Sugar maple--------- | 75<br>---<br>---<br>---<br>--- | Red maple, eastern white pine, white ash, white spruce. |
| HzB*, HzC2*:<br>Hortonville------- | 1o | Slight | Slight | Slight | Slight | Sugar maple---------<br>Northern red oak----<br>American basswood--- | 66<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| Boyer---------- | 3s | Slight | Slight | Moderate | Slight | Northern red oak----<br>White oak----------<br>Black oak----------<br>Northern pin oak---- | 60<br>---<br>---<br>--- | Eastern white pine, red pine. |
| Zurich---------- | 2o | Slight | Slight | Slight | Slight | Northern red oak----<br>White ash----------<br>American basswood---<br>Sugar maple--------- | 65<br>---<br>---<br>--- | Black walnut, eastern white pine, white spruce, red pine. |
| HzD2*:<br>Hortonville------- | 1r | Moderate | Moderate | Slight | Slight | Sugar maple---------<br>Northern red oak----<br>American basswood--- | 66<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| Boyer---------- | 3s | Moderate | Moderate | Slight | Slight | Northern red oak----<br>White oak----------<br>Black oak----------<br>Northern pin oak---- | 60<br>---<br>---<br>--- | Eastern white pine, red pine. |
| Zurich---------- | 2r | Moderate | Moderate | Slight | Slight | Northern red oak----<br>White ash----------<br>American basswood---<br>Sugar maple--------- | 65<br>---<br>---<br>--- | Black walnut, eastern white pine, white spruce, red pine. |

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| 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 | |
| HzE*: | | | | | | | | |
| Hortonville | 1r | Moderate | Moderate | Slight | Slight | Sugar maple<br>Northern red oak<br>American basswood | 66<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| Boyer | 3s | Moderate | Moderate | Moderate | Slight | Northern red oak<br>White oak<br>Black oak<br>Northern pin oak | 66<br>---<br>---<br>--- | Eastern white pine, red pine. |
| Zurich | 2r | Moderate | Moderate | Slight | Slight | Northern red oak<br>White ash<br>American basswood<br>Sugar maple | 65<br>---<br>---<br>--- | Black walnut, eastern white pine, white spruce, red pine. |
| KhB, KpB2, KpC2--<br>Kewaunee | 2c | Slight | Slight | Moderate | Slight | Northern red oak<br>Sugar maple<br>White ash<br>American basswood | 66<br>---<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| KpD2--<br>Kewaunee | 2c | Moderate | Moderate | Moderate | Slight | Northern red oak<br>Sugar maple<br>White ash<br>American basswood | 66<br>---<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| KsC3--<br>Kewaunee | 2c | Moderate | Slight | Moderate | Slight | Northern red oak<br>Sugar maple<br>White ash<br>American basswood | 66<br>---<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| KsD3, KsE3--<br>Kewaunee | 2c | Moderate | Moderate | Moderate | Slight | Northern red oak<br>Sugar maple<br>White ash<br>American basswood | 66<br>---<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| KtB*: | | | | | | | | |
| Kewaunee | 2c | Slight | Slight | Moderate | Slight | Northern red oak<br>Sugar maple<br>White ash<br>American basswood | 66<br>---<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| Manawa | 2c | Slight | Slight | Moderate | Slight | Northern red oak<br>Sugar maple<br>Green ash<br>Red maple | 61<br>---<br>---<br>--- | Red maple, green ash, white ash, white spruce. |
| KuA<br>Kibbie | 2o | Slight | Slight | Slight | Slight | Northern red oak<br>White oak<br>White ash<br>American basswood<br>Sugar maple | 66<br>---<br>66<br>66<br>--- | White spruce, eastern white pine, white ash, Norway spruce. |
| KvA<br>Kibbie Variant | 2o | Slight | Slight | Slight | Slight | Silver maple<br>Northern red oak<br>White ash | 88<br>---<br>--- | Silver maple, white spruce. |
| KwB, KwC2<br>Kolberg | 2c | Slight | Slight | Moderate | Moderate | Sugar maple<br>Northern red oak<br>White ash<br>American basswood | 66<br>---<br>---<br>--- | Eastern white pine, red pine, white spruce. |
| KxB<br>Kolberg Variant | 3d | Slight | Slight | Moderate | Moderate | Sugar maple<br>Red pine<br>Eastern white pine<br>Northern red oak<br>Northern white-cedar | 53<br>---<br>---<br>---<br>--- | Red pine. |

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| 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 | |
| LmA--- Lamartine | 2o | Slight | Slight | Slight | Slight | Northern red oak---- | 65 | Eastern white pine, red pine, white spruce. |
| | | | | | | American basswood--- | --- | |
| | | | | | | Sugar maple--------- | --- | |
| LoB--- Longrie | 2o | Slight | Slight | Slight | Slight | Sugar maple--------- | 61 | White spruce, red pine, eastern white pine. |
| | | | | | | Yellow birch-------- | --- | |
| | | | | | | American beech------ | --- | |
| | | | | | | Quaking aspen------- | --- | |
| | | | | | | Red pine------------ | --- | |
| | | | | | | Balsam fir---------- | --- | |
| McA--- Manawa | 2c | Slight | Slight | Slight | Slight | Northern red oak---- | 61 | Red maple, green ash, white ash, white spruce. |
| | | | | | | Sugar maple--------- | --- | |
| | | | | | | Green ash----------- | --- | |
| | | | | | | Red maple----------- | --- | |
| MeB--- Manistee | 3o | Slight | Slight | Moderate | Slight | Sugar maple--------- | 61 | Red pine. |
| | | | | | | Eastern white pine-- | --- | |
| | | | | | | Red maple----------- | --- | |
| | | | | | | Red pine------------ | --- | |
| | | | | | | American basswood--- | --- | |
| | | | | | | Eastern hemlock----- | --- | |
| | | | | | | Northern red oak---- | --- | |
| | | | | | | White ash----------- | --- | |
| Mk--- Markey | 3w | Slight | Severe | Severe | Severe | Northern white-cedar | 35 | |
| | | | | | | Balsam fir---------- | --- | |
| | | | | | | Black spruce-------- | --- | |
| | | | | | | Tamarack------------ | --- | |
| | | | | | | Black ash----------- | --- | |
| | | | | | | Quaking aspen------- | --- | |
| | | | | | | Paper birch--------- | --- | |
| MmA--- Matherton | 3o | Slight | Slight | Slight | Slight | Northern white-cedar | 39 | White spruce, Norway spruce, eastern white pine, northern white-cedar. |
| | | | | | | Swamp white oak----- | --- | |
| | | | | | | Bitternut hickory--- | --- | |
| | | | | | | White ash----------- | --- | |
| | | | | | | Northern pin oak---- | --- | |
| MrB--- Menominee | 1s | Slight | Slight | Slight | Slight | Northern red oak---- | 74 | Red pine, eastern white pine, white spruce. |
| | | | | | | Sugar maple--------- | --- | |
| | | | | | | American basswood--- | --- | |
| | | | | | | Red maple----------- | --- | |
| MsB--- Menominee Variant | 2s | Slight | Slight | Moderate | Slight | Red pine------------ | 60 | Red pine, eastern white pine, jack pine. |
| | | | | | | Northern red oak---- | --- | |
| | | | | | | Black oak----------- | --- | |
| MtA--- Mosel | 2o | Slight | Slight | Slight | Slight | Northern red oak---- | 65 | Eastern white pine, red pine, white spruce. |
| | | | | | | American basswood--- | --- | |
| | | | | | | Red maple----------- | --- | |
| My--- Mussey | 4w | Slight | Severe | Severe | Severe | Red maple----------- | 66 | White spruce, eastern white pine, black spruce, northern white-cedar. |
| | | | | | | White spruce-------- | --- | |
| | | | | | | Swamp white oak----- | --- | |
| | | | | | | White ash----------- | --- | |
| NaB--- Namur | 4d | Slight | Slight | Severe | Severe | Sugar maple--------- | 49 | Red pine, eastern white pine. |
| | | | | | | White ash----------- | --- | |
| | | | | | | Eastern white pine-- | --- | |
| | | | | | | Northern white-cedar | --- | |

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| 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 | |
| NrD*: | | | | | | | | |
| Namur | 4d | Moderate | Moderate | Severe | Severe | Sugar maple | 49 | Red pine, eastern white pine. |
| | | | | | | White ash | --- | |
| | | | | | | Eastern white pine | --- | |
| | | | | | | Northern white-cedar | --- | |
| Rock outcrop. | | | | | | | | |
| NxB | 1o | Slight | Slight | Slight | Slight | Sugar maple | 66 | Red pine, eastern white pine, white spruce. |
| Nichols | | | | | | Northern red oak | --- | |
| | | | | | | American basswood | --- | |
| | | | | | | White oak | --- | |
| OaB, OaC | 4s | Slight | Slight | Severe | Slight | Red pine | 45 | Red pine, eastern white pine, jack pine, Norway spruce, black spruce, black cherry. |
| Oakville | | | | | | Northern pin oak | --- | |
| | | | | | | White oak | --- | |
| | | | | | | Quaking aspen | --- | |
| | | | | | | Black oak | --- | |
| | | | | | | Eastern white pine | --- | |
| | | | | | | Jack pine | --- | |
| OdB, OeC2 | 2c | Slight | Slight | Severe | Severe | Northern red oak | 65 | Eastern white pine, red pine, white spruce. |
| Omro | | | | | | Sugar maple | --- | |
| | | | | | | White ash | --- | |
| | | | | | | Red maple | --- | |
| OhB, OhC2 | 2o | Slight | Slight | Slight | Slight | Sugar maple | 61 | White spruce, eastern white pine. |
| Onaway | | | | | | Quaking aspen | --- | |
| | | | | | | Balsam fir | --- | |
| | | | | | | Yellow birch | --- | |
| | | | | | | Northern red oak | --- | |
| | | | | | | Red pine | --- | |
| | | | | | | American basswood | --- | |
| | | | | | | White ash | --- | |
| Pe | 4w | Slight | Severe | Severe | Severe | Red maple | 66 | Red maple, white ash, white spruce. |
| Pella | | | | | | White ash | --- | |
| Po | 2w | Slight | Severe | Moderate | Moderate | White ash | 65 | White spruce, black spruce, red maple, silver maple. |
| Poygan | | | | | | Red maple | --- | |
| | | | | | | Silver maple | --- | |
| | | | | | | American elm | --- | |
| RcE*: | | | | | | | | |
| Rodman | 4f | Moderate | Severe | Severe | Slight | Northern red oak | 45 | Red pine, eastern white pine, eastern redcedar. |
| | | | | | | White oak | --- | |
| | | | | | | Red pine | --- | |
| Casco | 3s | Moderate | Moderate | Moderate | Moderate | Northern red oak | 55 | Red pine, eastern redcedar, eastern white pine. |
| | | | | | | Black oak | --- | |
| | | | | | | White oak | --- | |
| Rs | 4w | Slight | Severe | Severe | Moderate | Quaking aspen | 49 | Red maple, white ash, white spruce. |
| Roscommon | | | | | | Black spruce | --- | |
| | | | | | | Northern white-cedar | --- | |
| | | | | | | Jack pine | --- | |
| | | | | | | Silver maple | --- | |
| | | | | | | Red maple | --- | |
| | | | | | | Yellow birch | --- | |
| | | | | | | Balsam fir | --- | |
| | | | | | | Eastern hemlock | --- | |
| Ru | 4w | Slight | Severe | Moderate | Moderate | Balsam fir | 45 | Black spruce, northern white-cedar, balsam fir. |
| Ruse | | | | | | Black spruce | 45 | |
| | | | | | | Northern white-cedar | --- | |
| | | | | | | White ash | --- | |
| | | | | | | Paper birch | --- | |
| | | | | | | Quaking aspen | --- | |

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| 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 | |
| ShA---------- Shiocton | 2o | Slight | Slight | Slight | Slight | Red maple---------- | 65 | Eastern white pine, white spruce, silver maple, white ash. |
| | | | | | | Sugar maple---------- | --- | |
| | | | | | | Northern red oak---- | --- | |
| | | | | | | American basswood--- | --- | |
| | | | | | | American beech------ | --- | |
| SoA---------- Solona | 2o | Slight | Slight | Slight | Slight | Sugar maple---------- | 63 | Eastern white pine, red pine, white spruce. |
| | | | | | | Northern red oak---- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| SyA---------- Symco | 1o | Slight | Slight | Slight | Slight | Northern red oak---- | 75 | Red maple, eastern white pine, white ash, white spruce. |
| | | | | | | Red maple---------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| | | | | | | Sugar maple---------- | --- | |
| WaA---------- Wainola | 1o | Slight | Slight | Severe | Slight | Northern red oak---- | 74 | White spruce, eastern white pine, red maple, white ash. |
| | | | | | | Quaking aspen------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | Red maple---------- | --- | |
| We---------- Wauseon | 3w | Slight | Severe | Severe | Severe | Silver maple-------- | 70 | Silver maple. |
| | | | | | | White ash---------- | --- | |
| | | | | | | Swamp white oak----- | --- | |
| WoB, WoC2---------- Waymor | 2o | Slight | Slight | Slight | Slight | Northern red oak---- | 63 | Eastern white pine, red pine, white spruce. |
| | | | | | | Sugar maple---------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| WoD2---------- Waymor | 2r | Moderate | Moderate | Slight | Slight | Northern red oak---- | 63 | Eastern white pine, red pine, white spruce. |
| | | | | | | Sugar maple---------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| WzB*, WzC2*: Waymor---------- | 2o | Slight | Slight | Slight | Slight | Northern red oak---- | 63 | Eastern white pine, red pine, white spruce. |
| | | | | | | Sugar maple---------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| Casco---------- | 3s | Slight | Slight | Moderate | Moderate | Northern red oak---- | 55 | Red pine, eastern redcedar, eastern white pine. |
| | | | | | | Black oak---------- | --- | |
| | | | | | | White oak---------- | --- | |
| Zurich---------- | 2o | Slight | Slight | Slight | Slight | Northern red oak---- | 65 | Eastern white pine, white spruce, red pine. |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| | | | | | | Sugar maple---------- | --- | |
| WzD*, WzE*: Waymor---------- | 2r | Moderate | Moderate | Slight | Slight | Northern red oak---- | 63 | Eastern white pine, red pine, white spruce. |
| | | | | | | Sugar maple---------- | --- | |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| Casco---------- | 3s | Moderate | Moderate | Moderate | Moderate | Northern red oak---- | 55 | Red pine, eastern redcedar, eastern white pine. |
| | | | | | | Black oak---------- | --- | |
| | | | | | | White oak---------- | --- | |
| Zurich---------- | 2r | Moderate | Moderate | Slight | Slight | Northern red oak---- | 65 | Eastern white pine, white spruce, red pine. |
| | | | | | | White ash---------- | --- | |
| | | | | | | American basswood--- | --- | |
| | | | | | | Sugar maple---------- | --- | |

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| 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 | |
| ZuA, ZuB, ZuC2----- Zurich | 2o | Slight | Slight | Slight | Slight | Northern red oak----<br>White ash----------<br>American basswood---<br>Sugar maple--------- | 65<br>---<br>---<br>--- | Black walnut, eastern white pine, white spruce, red pine. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--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 heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| AdA---------- Allendale | --- | American cranberrybush; silky dogwood---- | White spruce, black spruce, northern white-cedar, tall purple willow. | Eastern white pine | --- |
| Ax---------- Angelica | --- | Silky dogwood----- | Northern white-cedar, black spruce, white spruce. | --- | Carolina poplar. |
| Ba---------- Bach | --- | Austrian pine, silky dogwood, whitebelle honeysuckle, late lilac. | Green ash, northern white-cedar, eastern white pine. | --- | Carolina poplar. |
| Bn---------- Bonduel | --- | Northern white-cedar, redosier dogwood, nannyberry viburnum. | Green ash, white spruce. | Eastern white pine, jack pine, silver maple. | --- |
| Bo* Borosaprists | | | | | |
| BrB, BrC, BrE----- Boyer | Silky dogwood----- | Nannyberry viburnum. | Norway spruce----- | Eastern white pine, white ash, red pine. | --- |
| Ca---------- Carbondale | --- | --- | --- | --- | --- |
| CbA, CbB, CbC2---- Casco | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| CdB*, CdC2*, CdD2*: Casco---------- | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Rodman---------- | Gray dogwood, lilac. | Late lilac-------- | Eastern redcedar, Norway spruce. | Eastern white pine, red pine, jack pine. | --- |
| Cm---------- Cathro | --- | --- | --- | --- | --- |
| DrA, DrB---------- Dresden | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| FaA---------- Fabius | Redosier dogwood | Nannyberry viburnum. | Northern white-cedar, eastern white pine, white spruce. | --- | Carolina poplar. |
| Fu*. Fluvaquents | | | | | |

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| HrB, HrC2, HrD2---<br>Hortonville | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| HsB*:<br>Hortonville------ | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Symco---------- | --- | Northern white-cedar, redosier dogwood, nannyberry viburnum. | White spruce, green ash. | Eastern white pine, jack pine, silver maple. | --- |
| HzB*, HzC2*:<br>Hortonville------ | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Boyer---------- | Silky dogwood----- | Nannyberry viburnum. | Norway spruce----- | Eastern white pine, jack pine, white ash, red pine. | --- |
| Zurich---------- | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| HzD2*:<br>Hortonville------ | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Boyer. | | | | | |
| Zurich. | | | | | |
| HzE*:<br>Hortonville------ | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Boyer---------- | Silky dogwood----- | Nannyberry viburnum. | Norway spruce----- | Eastern white pine, jack pine, white ash. | --- |
| Zurich---------- | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| KhB, KpB2, KpC2, KpD2, KsC3, KsD3, KsE3----------<br>Kewaunee | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| KtB*:<br>Kewaunee--------- | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| KtB*: Manawa | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| KuA Kibbie | --- | Silky dogwood, American cranberrybush. | White spruce | Red pine, eastern white pine. | Carolina poplar, white ash. |
| KvA Kibbie Variant | --- | Northern white-cedar, redosier dogwood, nannyberry viburnum. | Green ash, white spruce. | Eastern white pine, jack pine, silver maple. | --- |
| KwB, KwC2 Kolberg | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| KxB Kolberg Variant | Manyflower cotoneaster. | Lilac | Norway spruce, Siberian peashrub. | Eastern white pine, red pine, jack pine. | --- |
| LmA Lamartine | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| LoB Longrie | --- | Northern white-cedar. | Red pine, white spruce. | Eastern white pine. | Red maple. |
| McA Manawa | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| MeB Manistee | --- | Siberian peashrub | Siberian crabapple, hawthorn, Norway spruce. | Red pine, eastern white pine. | --- |
| Mk Markey | --- | --- | --- | --- | --- |
| MmA Matherton | --- | Silky dogwood, northern white-cedar. | White spruce | Eastern white pine. | Carolina poplar. |
| MrB Menominee | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| MsB Menominee Variant | Manyflower cotoneaster. | Lilac | Norway spruce, Siberian peashrub. | Eastern white pine, red pine, jack pine. | --- |
| MtA Mosel | --- | Northern white-cedar, nannyberry viburnum, redosier dogwood. | White spruce, green ash. | Eastern white pine, jack pine, silver maple. | --- |
| My Mussey | --- | Hawthorn, shadblow serviceberry, silky dogwood, balsam fir. | White spruce | White ash | Carolina poplar. |
| NaB Namur | Manyflower cotoneaster. | Lilac | Norway spruce, Siberian peashrub. | Eastern white pine, red pine, jack pine. | --- |

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| NrD*: | | | | | |
| Namur | Manyflower cotoneaster. | Lilac | Norway spruce, Siberian peashrub. | Eastern white pine, red pine, jack pine. | --- |
| Rock outcrop. | | | | | |
| NxB---- Nichols | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| OaB, OaC---- Oakville | Siberian peashrub | Lilac | Red pine, Siberian crabapple. | Eastern white pine, jack pine. | --- |
| OdB, OeC2---- Omro | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| OhB, OhC2---- Onaway | Silky dogwood | Lilac | White spruce | Red pine, eastern white pine. | --- |
| Pe---- Pella | Redosier dogwood, gray dogwood. | Amur maple, silky dogwood, northern white-cedar. | White spruce | Green ash, white ash, red maple. | Carolina poplar. |
| Pg*. Pits | | | | | |
| Po---- Poygan | --- | Northern white-cedar, redosier dogwood, nannyberry viburnum. | Green ash, white spruce. | Eastern white pine, silver maple. | --- |
| RcE*: | | | | | |
| Rodman | Silky dogwood, Siberian peashrub. | Late lilac | Eastern redcedar, Norway spruce. | Eastern white pine, red pine, jack pine. | --- |
| Casco | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Rs---- Roscommon | --- | Arrowwood, hawthorn, nannyberry viburnum, silky dogwood. | White spruce | Red maple, white ash. | Carolina poplar. |
| Ru. Ruse | | | | | |
| ShA---- Shiocton | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | |
| SoA---- Solona | --- | Northern white-cedar, redosier dogwood, nannyberry viburnum. | Green ash, white spruce. | Eastern white pine, jack pine, silver maple. | --- |
| SyA---- Symco | --- | Northern white-cedar, redosier dogwood, nannyberry viburnum. | White spruce, green ash. | Eastern white pine, jack pine, silver maple. | --- |

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| Uf*. Udifluvents | | | | | |
| UoB*, UoF*. Udorthents | | | | | |
| WaA---------- Wainola | Redosier dogwood | Northern white-cedar. | White spruce------ | Red pine, eastern white pine. | Carolina poplar. |
| We---------- Wauseon | Redosier dogwood | Nannyberry viburnum. | White spruce------ | Red pine, white ash. | --- |
| WoB, WoC2, WoD2--- Waymor | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| WzB*, WzC2*, WzD*, WzE*: | | | | | |
| Waymor---------- | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Casco---------- | --- | Northern white-cedar, lilac, common ninebark, silky dogwood. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| Zurich---------- | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |
| ZuA, ZuB, ZuC2---- Zurich | --- | Northern white-cedar, common ninebark, silky dogwood, lilac. | White spruce, Norway spruce. | Eastern white pine, red pine. | --- |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--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 |
|---|---|---|---|---|---|
| AdA<br>Allendale | Severe:<br>wetness. | Severe:<br>wetness. | Severe:<br>wetness. | Moderate:<br>wetness,<br>too sandy. | Severe:<br>wetness. |
| Ax<br>Angelica | Severe:<br>floods,<br>wetness. | Severe:<br>wetness. | Severe:<br>wetness,<br>floods. | Severe:<br>wetness. | Severe:<br>wetness,<br>floods. |
| Ba<br>Bach | Severe:<br>wetness,<br>floods. | Severe:<br>wetness. | Severe:<br>wetness,<br>floods. | Severe:<br>wetness. | Severe:<br>wetness,<br>floods. |
| Bn<br>Bonduel | Severe:<br>floods,<br>wetness. | Moderate:<br>wetness. | Severe:<br>wetness. | Moderate:<br>wetness. | Moderate:<br>wetness,<br>thin layer. |
| Bo*.<br>Borosaprists | | | | | |
| BrB<br>Boyer | Moderate:<br>too sandy. | Moderate:<br>too sandy. | Moderate:<br>small stones,<br>slope. | Moderate:<br>too sandy. | Moderate:<br>too sandy. |
| BrC<br>Boyer | Moderate:<br>too sandy,<br>slope. | Moderate:<br>too sandy,<br>slope. | Severe:<br>slope. | Moderate:<br>too sandy. | Moderate:<br>too sandy,<br>slope. |
| BrE<br>Boyer | Severe:<br>slope. | Severe:<br>slope. | Severe:<br>slope. | Severe:<br>slope. | Severe:<br>slope. |
| Ca<br>Carbondale | Severe:<br>wetness,<br>floods,<br>excess humus. | Severe:<br>wetness,<br>excess humus. | Severe:<br>wetness,<br>floods,<br>excess humus. | Severe:<br>wetness,<br>excess humus. | Severe:<br>excess humus,<br>wetness,<br>floods. |
| CbA<br>Casco | Slight | Slight | Slight | Slight | Slight. |
| CbB<br>Casco | Slight | Slight | Moderate:<br>slope. | Slight | Slight. |
| CbC2<br>Casco | Moderate:<br>slope. | Moderate:<br>slope. | Severe:<br>slope. | Slight | Moderate:<br>slope. |
| CdB*:<br>Casco | Slight | Slight | Moderate:<br>slope. | Slight | Slight. |
| Rodman | Slight | Slight | Moderate:<br>slope,<br>small stones. | Slight | Severe:<br>small stones. |
| CdC2*:<br>Casco | Moderate:<br>slope. | Moderate:<br>slope. | Severe:<br>slope. | Slight | Moderate:<br>slope. |
| Rodman | Moderate:<br>slope. | Moderate:<br>slope. | Severe:<br>slope. | Slight | Severe:<br>small stones. |
| CdD2*:<br>Casco | Severe:<br>slope. | Severe:<br>slope. | Severe:<br>slope. | Moderate:<br>slope. | Severe:<br>slope. |

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| CdD2*: Rodman | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope, small stones. |
| Cm---- Cathro | Severe: wetness, floods, excess humus. | Severe: wetness, excess humus. | Severe: wetness, floods, excess humus. | Severe: wetness, excess humus. | Severe: excess humus, wetness, floods. |
| DrA---- Dresden | Slight---- | Slight---- | Slight---- | Slight---- | Slight. |
| DrB---- Dresden | Slight---- | Slight---- | Moderate: slope. | Slight---- | Slight. |
| FaA---- Fabius | Severe: floods, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness. |
| Fu*. Fluvaquents | | | | | |
| HrB---- Hortonville | Slight---- | Slight---- | Moderate: slope. | Slight---- | Slight. |
| HrC2---- Hortonville | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---- | Moderate: slope. |
| HrD2---- Hortonville | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| HsB*: Hortonville---- | Slight---- | Slight---- | Moderate: slope. | Slight---- | Slight. |
| Symco---- | Severe: floods, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| HzB*: Hortonville---- | Slight---- | Slight---- | Moderate: slope. | Slight---- | Slight. |
| Boyer---- | Moderate: too sandy. | Moderate: too sandy. | Moderate: small stones, slope. | Moderate: too sandy. | Moderate: too sandy. |
| Zurich---- | Slight---- | Slight---- | Moderate: slope. | Slight---- | Slight. |
| HzC2*: Hortonville---- | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---- | Moderate: slope. |
| Boyer---- | Moderate: too sandy, slope. | Moderate: too sandy, slope. | Severe: slope. | Moderate: too sandy. | Moderate: too sandy, slope. |
| Zurich---- | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---- | Moderate: slope. |
| HzD2*: Hortonville---- | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| HzD2*: | | | | | |
| Boyer | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: too sandy, slope. | Severe: slope. |
| Zurich | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| HzE*: | | | | | |
| Hortonville | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Boyer | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Zurich | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| KhB<br>Kewaunee | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: percs slowly. | Slight | Slight. |
| KpB2<br>Kewaunee | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: too clayey, percs slowly. | Slight | Slight. |
| KpC2<br>Kewaunee | Moderate: percs slowly. | Moderate: percs slowly. | Severe: slope. | Slight | Moderate: slope. |
| KpD2<br>Kewaunee | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| KsC3<br>Kewaunee | Severe: too clayey. | Severe: too clayey. | Severe: too clayey, slope. | Severe: too clayey. | Severe: too clayey. |
| KsD3<br>Kewaunee | Severe: too clayey, slope. | Severe: slope, too clayey. | Severe: too clayey, slope. | Severe: too clayey. | Severe: slope. |
| KsE3<br>Kewaunee | Severe: too clayey, slope. | Severe: slope, too clayey. | Severe: too clayey, slope. | Severe: slope, too clayey. | Severe: slope. |
| KtB*: | | | | | |
| Kewaunee | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: percs slowly. | Slight | Slight. |
| Manawa | Severe: floods, wetness. | Moderate: wetness, percs slowly. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| KuA<br>Kibbie | Severe: wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness. |
| KvA<br>Kibbie Variant | Severe: floods, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| KwB<br>Kolberg | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: slope, depth to rock, percs slowly. | Slight | Moderate: thin layer. |
| KwC2<br>Kolberg | Moderate: slope, percs slowly. | Moderate: slope, percs slowly. | Severe: slope. | Slight | Moderate: slope, thin layer. |

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| KxB---------- Kolberg Variant | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Slight---------- | Severe: thin layer. |
| LmA---------- Lamartine | Severe: wetness, floods. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| LoB---------- Longrie | Slight---------- | Slight---------- | Moderate: slope, small stones, depth to rock. | Slight---------- | Moderate: thin layer. |
| McA---------- Manawa | Severe: floods, wetness. | Moderate: wetness, percs slowly. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| MeB---------- Manistee | Moderate: percs slowly. | Moderate: too sandy. | Moderate: slope, too sandy. | Moderate: too sandy. | Moderate: too sandy. |
| Mk---------- Markey | Severe: wetness, floods, excess humus. | Severe: wetness, excess humus. | Severe: wetness, floods, excess humus. | Severe: wetness, excess humus. | Severe: excess humus, wetness, floods. |
| MmA---------- Matherton | Severe: wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness. |
| MrB---------- Menominee | Moderate: too sandy. | Moderate: too sandy. | Moderate: slope, too sandy. | Moderate: too sandy. | Moderate: too sandy. |
| MsB---------- Menominee Variant | Moderate: too sandy. | Moderate: too sandy. | Moderate: slope, too sandy. | Moderate: too sandy. | Moderate: too sandy. |
| MtA---------- Mosel | Severe: floods, wetness. | Moderate: wetness, floods. | Severe: wetness, floods. | Moderate: wetness, floods. | Severe: floods. |
| My---------- Mussey | Severe: wetness, floods. | Severe: wetness. | Severe: wetness, floods. | Severe: wetness. | Severe: wetness. |
| NaB---------- Namur | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Slight---------- | Severe: thin layer. |
| NrD*: Namur---------- | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock, slope. | Slight---------- | Severe: thin layer. |
| Rock outcrop. | | | | | |
| NxB---------- Nichols | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |
| OaB---------- Oakville | Moderate: too sandy. | Moderate: too sandy. | Moderate: too sandy, slope. | Moderate: too sandy. | Moderate: too sandy. |
| OaC---------- Oakville | Moderate: too sandy, slope. | Moderate: too sandy, slope. | Severe: slope. | Moderate: too sandy. | Moderate: too sandy, slope. |
| OdB---------- Omro | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: slope, percs slowly. | Slight---------- | Slight. |

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| OeC2---------- Omro | Moderate: slope, percs slowly. | Moderate: slope, percs slowly. | Severe: slope. | Slight---------- | Moderate: slope. |
| OhB---------- Onaway | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |
| OhC2---------- Onaway | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---------- | Moderate: slope. |
| Pe---------- Pella | Severe: wetness, floods. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. |
| Pg*. Pits | | | | | |
| Po---------- Poygan | Severe: floods, wetness. | Severe: wetness. | Severe: wetness, floods. | Severe: wetness. | Severe: wetness, floods. |
| RcE*: Rodman---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope, small stones. |
| Casco---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Rs---------- Roscommon | Severe: wetness, floods. | Severe: wetness. | Severe: wetness, floods. | Severe: wetness. | Severe: wetness, floods. |
| Ru---------- Ruse | Severe: floods, wetness. | Severe: wetness. | Severe: wetness, floods, depth to rock. | Severe: wetness. | Severe: wetness, floods, thin layer. |
| ShA---------- Shiocton | Severe: floods, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| ScA---------- Solona | Severe: floods, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| SyA---------- Symco | Severe: floods, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, floods. |
| Uf*. Udifluvents | | | | | |
| UoB*, UoF*. Udorthents | | | | | |
| WaA---------- Wainola | Severe: wetness. | Moderate: wetness, too sandy. | Severe: wetness. | Moderate: wetness, too sandy. | Moderate: too sandy, wetness. |
| We---------- Wauseon | Severe: wetness, percs slowly. | Severe: wetness. | Severe: wetness, percs slowly. | Severe: wetness. | Severe: wetness. |
| WoB---------- Waymor | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| WoC2---------- Waymor | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---------- | Moderate: slope. |
| WoD2---------- Waymor | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| WzB*: | | | | | |
| Waymor---------- | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |
| Casco---------- | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |
| Zurich---------- | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |
| WzC2*: | | | | | |
| Waymor---------- | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---------- | Moderate: slope. |
| Casco---------- | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---------- | Moderate: slope. |
| Zurich---------- | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---------- | Moderate: slope. |
| WzD*: | | | | | |
| Waymor---------- | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| Casco---------- | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| Zurich---------- | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| WzE*: | | | | | |
| Waymor---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Casco---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Zurich---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| ZuA---------- Zurich | Slight---------- | Slight---------- | Slight---------- | Slight---------- | Slight. |
| ZuB---------- Zurich | Slight---------- | Slight---------- | Moderate: slope. | Slight---------- | Slight. |
| ZuC2---------- Zurich | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight---------- | Moderate: slope. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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 |
| AdA---------- Allendale | Poor | Poor | Good | Fair | Fair | Poor | Fair | Fair | Fair | Poor. |
| Ax---------- Angelica | Good | Fair | Poor | Poor | Poor | Good | Good | Fair | Poor | Good. |
| Ba---------- Bach | Good | Good | Poor | Poor | Poor | Good | Good | Good | Poor | Good. |
| Bn---------- Bonduel | Fair | Good | Good | Good | Good | Fair | Fair | Good | Good | Fair. |
| Bo* Borosaprists | | | | | | | | | | |
| BrB, BrC---------- Boyer | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| BrE---------- Boyer | Very poor. | Fair | Good | Good | Good | Very poor. | Very poor. | Poor | Good | Very poor. |
| Ca---------- Carbondale | Fair | Poor | Poor | Poor | Poor | Good | Good | Poor | Poor | Good. |
| CbA, CbB, CbC2----- Casco | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| CdB*, CdC2*: Casco---------- | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Rodman---------- | Very poor. | Poor | Fair | Poor | Poor | Very poor. | Very poor. | Poor | Poor | Very poor. |
| CdD2*: Casco---------- | Poor | Fair | Fair | Fair | Fair | Very poor. | Very poor. | Fair | Fair | Very poor. |
| Rodman---------- | Very poor. | Poor | Fair | Poor | Poor | Very poor. | Very poor. | Poor | Poor | Very poor. |
| Cm---------- Cathro | Poor | Fair | Fair | Fair | Fair | Good | Good | Poor | Poor | Good. |
| DrA, DrB---------- Dresden | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| FaA---------- Fabius | Poor | Poor | Fair | Fair | Fair | Fair | Fair | Poor | Fair | Fair. |
| Fu*. Fluvaquents | | | | | | | | | | |
| HrB, HrC2---------- Hortonville | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| HrD2---------- Hortonville | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| HsB*: Hortonville------- | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |

See footnote at end of table.

TABLE 9.--WILDLIFE HATIBAT--Continued

| 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 |
| HsB*: | | | | | | | | | | |
| Symco | Good | Good | Good | Good | Good | Fair | Fair | Good | Good | Fair. |
| HzB*, HzC2*: | | | | | | | | | | |
| Hortonville | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Boyer | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| Zurich | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| HzD2*: | | | | | | | | | | |
| Hortonville | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Boyer | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| Zurich | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| HzE*: | | | | | | | | | | |
| Hortonville | Very poor. | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| Boyer | Very poor. | Fair | Good | Good | Good | Very poor. | Very poor. | Poor | Good | Very poor. |
| Zurich | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| KhB, KpB2, KpC2--- Kewaunee | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| KpD2--- Kewaunee | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| KsC3--- Kewaunee | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| KsD3--- Kewaunee | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| KsE3--- Kewaunee | Very poor. | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| KtB*: | | | | | | | | | | |
| Kewaunee | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| Manawa | Good | Good | Good | Good | Good | Poor | Poor | Good | Good | Good. |
| KuA--- Kibbie | Good | Good | Good | Good | Fair | Fair | Fair | Good | Good | Fair. |
| KvA--- Kibbie Variant | Good | Good | Good | Good | Good | Fair | Fair | Good | Good | Fair. |
| KwB, KwC2--- Kolberg | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| KxB--- Kolberg Variant | Poor | Poor | Fair | Fair | Fair | Very poor. | Very poor. | Poor | Fair | Very poor. |

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

| 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 |
| LmA---- Lamartine | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good. |
| LoB---- Longrie | Fair | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| McA---- Manawa | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good. |
| MeB---- Manistee | Poor | Poor | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| Mk---- Markey | Fair | Poor | Poor | Poor | Poor | Good | Good | Poor | Poor | Fair. |
| MmA---- Matherton | Good | Good | Good | Good | Fair | Fair | Fair | Good | Good | Fair. |
| MrB---- Menominee | Poor | Fair | Good | Fair | Fair | Very poor. | Very poor. | Fair | Fair | Very poor. |
| MsB---- Menominee Variant | Fair | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| MtA---- Mosel | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good. |
| My---- Mussey | Fair | Poor | Poor | Poor | Poor | Good | Good | Poor | Poor | Good. |
| NaB---- Namur | Very poor. | Very poor. | Poor | Poor | Poor | Very poor. | Very poor. | Very poor. | Poor | Very poor. |
| NrD*: Namur---- | Very poor. | Very poor. | Poor | Poor | Poor | Very poor. | Very poor. | Very poor. | Poor | Very poor. |
| Rock outcrop. | | | | | | | | | | |
| NxB---- Nichols | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| OaB---- Oakville | Poor | Fair | Fair | Fair | Fair | Poor | Very poor. | Fair | Fair | Very poor. |
| OaC---- Oakville | Poor | Fair | Fair | Fair | Fair | Very poor. | Very poor. | Fair | Fair | Very poor. |
| OdB, OeC2---- Omro | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| OhB---- Onaway | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| OhC2---- Onaway | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Pe---- Pella | Good | Good | Good | Fair | Poor | Good | Good | Good | Fair | Fair. |
| Pg*. Pits | | | | | | | | | | |
| Po---- Poygan | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good. |

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

| 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 |
| RcE*: | | | | | | | | | | |
| Rodman | Very poor. | Poor | Fair | Poor | Poor | Very poor. | Very poor. | Poor | Poor | Very poor. |
| Casco | Poor | Fair | Fair | Fair | Fair | Very poor. | Very poor. | Fair | Fair | Very poor. |
| Rs<br>Roscommon | Very poor. | Poor | Poor | Poor | Poor | Good | Good | Poor | Poor | Good. |
| Ru<br>Ruse | Poor | Fair | Fair | Poor | Poor | Good | Poor | Fair | Poor | Fair. |
| ShA<br>Shiocton | Good | Good | Good | Good | Good | Poor | Poor | Good | Good | Poor. |
| SoA<br>Solona | Good | Good | Good | Good | Good | Fair | Fair | Good | Good | Fair. |
| SyA<br>Symco | Good | Good | Good | Good | Good | Fair | Fair | Good | Good | Fair. |
| Uf*.<br>Udifluvents | | | | | | | | | | |
| UoB*, UoF*.<br>Udorthents | | | | | | | | | | |
| WaA<br>Wainola | Poor | Poor | Fair | Fair | Fair | Poor | Poor | Poor | Fair | Poor. |
| We<br>Wauseon | Poor | Poor | Poor | Poor | Poor | Good | Good | Poor | Poor | Good. |
| WoB<br>Waymor | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| WoC2<br>Waymor | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| WoD2<br>Waymor | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| WzB*: | | | | | | | | | | |
| Waymor | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| Casco | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Zurich | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| WzC2*: | | | | | | | | | | |
| Waymor | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Casco | Good | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| Zurich | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| WzD*: | | | | | | | | | | |
| Waymor | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |

See footnote at end of table.

TABLE 9.--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 |
| WzD*: | | | | | | | | | | |
| Casco | Poor | Fair | Fair | Fair | Fair | Very poor. | Very poor. | Fair | Fair | Very poor. |
| Zurich | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| WzE*: | | | | | | | | | | |
| Waymor | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| Casco | Poor | Fair | Fair | Fair | Fair | Very poor. | Very poor. | Fair | Fair | Very poor. |
| Zurich | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| ZuA, ZuB, ZuC2----- Zurich | 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 10.--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 |
|---|---|---|---|---|---|---|
| AdA---------- Allendale | Severe: wetness. | Severe: wetness, low strength, shrink-swell. | Severe: wetness, shrink-swell, low strength. | Severe: wetness, low strength, shrink-swell. | Severe: low strength, shrink-swell, wetness. | Severe: wetness. |
| Ax---------- Angelica | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, frost action, floods. | Severe: wetness, floods. |
| Ba---------- Bach | Severe: wetness, cutbanks cave, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, frost action, floods. | Severe: wetness, floods. |
| Bn---------- Bonduel | Severe: wetness, depth to rock. | Severe: wetness, floods. | Severe: wetness, depth to rock, floods. | Severe: wetness, floods. | Severe: frost action. | Moderate: wetness, thin layer. |
| Bo*. Borosaprists | | | | | | |
| BrB---------- Boyer | Severe: cutbanks cave. | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: too sandy. |
| BrC---------- Boyer | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: too sandy, slope. |
| BrE---------- Boyer | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Ca---------- Carbondale | Severe: wetness, floods, excess humus. | Severe: wetness, floods, low strength. | Severe: wetness, floods, low strength. | Severe: wetness, floods, low strength. | Severe: wetness, floods, low strength. | Severe: excess humus, wetness, floods. |
| CbA---------- Casco | Severe: cutbanks cave. | Slight--------- | Slight--------- | Slight--------- | Moderate: frost action. | Slight. |
| CbB---------- Casco | Severe: cutbanks cave. | Slight--------- | Slight--------- | Moderate: slope. | Moderate: frost action. | Slight. |
| CbC2---------- Casco | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope, frost action. | Moderate: slope. |
| CdB*: Casco---------- | Severe: cutbanks cave. | Slight--------- | Slight--------- | Moderate: slope. | Moderate: frost action. | Slight. |
| Rodman---------- | Severe: cutbanks cave. | Slight--------- | Slight--------- | Moderate: slope. | Slight--------- | Severe: small stones. |
| CdC2*: Casco---------- | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope, frost action. | Moderate: slope. |
| Rodman---------- | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Severe: small stones. |

See footnote at end of table.

TABLE 10.--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 |
|---|---|---|---|---|---|---|
| CdD2*: | | | | | | |
| Casco | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Rodman | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope, small stones. |
| Cm | Severe: wetness, floods, excess humus. | Severe: wetness, floods, low strength. | Severe: wetness, floods, low strength. | Severe: wetness, floods, low strength. | Severe: wetness, frost action, floods. | Severe: excess humus, wetness, floods. |
| DrA | Severe: cutbanks cave. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| DrB | Severe: cutbanks cave. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: slope, shrink-swell. | Severe: low strength. | Slight. |
| FaA | Severe: wetness, cutbanks cave. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: frost action. | Moderate: wetness. |
| Fu*. Fluvaquents | | | | | | |
| HrB | Slight | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| HrC2 | Moderate: slope. | Moderate: slope, shrink-swell. | Moderate: shrink-swell, slope. | Severe: slope. | Severe: low strength. | Moderate: slope. |
| HrD2 | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: low strength, slope. | Severe: slope. |
| HsB*: | | | | | | |
| Hortonville | Slight | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| Symco | Severe: wetness, floods. | Severe: floods, wetness. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: frost action, low strength, floods. | Moderate: wetness, floods. |
| HzB*: | | | | | | |
| Hortonville | Slight | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: slope, shrink-swell. | Severe: low strength. | Slight. |
| Boyer | Severe: cutbanks cave. | Slight | Slight | Moderate: slope. | Slight | Moderate: too sandy. |
| Zurich | Severe: cutbanks cave. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell, slope. | Severe: frost action, low strength. | Slight. |
| HzC2*: | | | | | | |
| Hortonville | Moderate: slope. | Moderate: slope, shrink-swell. | Moderate: shrink-swell, slope. | Severe: slope. | Severe: low strength. | Moderate: slope. |
| Boyer | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: too sandy, slope. |

See footnote at end of table.

TABLE 10.--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 |
|---|---|---|---|---|---|---|
| HzC2*: Zurich | Severe: cutbanks cave. | Moderate: slope, shrink-swell. | Moderate: slope, shrink-swell. | Severe: slope. | Severe: frost action, low strength. | Moderate: slope. |
| HzD2*, HzE*: Hortonville | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: low strength, slope. | Severe: slope. |
| Boyer | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Zurich | Severe: slope, cutbanks cave. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: frost action, slope, low strength. | Severe: slope. |
| KhB, KpB2 Kewaunee | Moderate: too clayey. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: low strength, shrink-swell. | Slight. |
| KpC2 Kewaunee | Moderate: too clayey, slope. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: slope, shrink-swell. | Severe: low strength, shrink-swell. | Moderate: slope. |
| KpD2 Kewaunee | Severe: slope. | Severe: slope, shrink-swell. | Severe: slope, shrink-swell. | Severe: slope, shrink-swell. | Severe: low strength, slope. | Severe: slope. |
| KsC3 Kewaunee | Moderate: too clayey, slope. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: slope, shrink-swell. | Severe: low strength, shrink-swell. | Severe: too clayey. |
| KsD3, KsE3 Kewaunee | Severe: slope. | Severe: slope, shrink-swell. | Severe: slope, shrink-swell. | Severe: slope, shrink-swell. | Severe: low strength, slope. | Severe: slope. |
| KtB*: Kewaunee | Moderate: too clayey. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: low strength, shrink-swell. | Slight. |
| Manawa | Severe: wetness, too clayey, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: floods, low strength, wetness. | Moderate: wetness, floods. |
| KuA Kibbie | Severe: wetness, cutbanks cave. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness, frost action, low strength. | Moderate: wetness. |
| KvA Kibbie Variant | Severe: wetness, floods. | Severe: floods, wetness. | Severe: floods, wetness. | Severe: floods, wetness. | Severe: low strength, floods, frost action. | Moderate: wetness, floods. |
| KwB Kolberg | Severe: depth to rock. | Moderate: shrink-swell. | Severe: depth to rock. | Moderate: shrink-swell. | Severe: low strength. | Moderate: thin layer. |
| KwC2 Kolberg | Severe: depth to rock. | Moderate: shrink-swell, slope. | Severe: depth to rock. | Severe: slope. | Severe: low strength. | Moderate: slope, thin layer. |
| KxB Kolberg Variant | Severe: depth to rock. | Moderate: shrink-swell, depth to rock. | Severe: depth to rock. | Moderate: shrink-swell, depth to rock. | Severe: low strength, depth to rock. | Severe: thin layer. |

See footnote at end of table.

TABLE 10.--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 |
|---|---|---|---|---|---|---|
| LmA---------- Lamartine | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods, low strength. | Moderate: wetness, floods. |
| LoB---------- Longrie | Severe: depth to rock. | Moderate: depth to rock. | Severe: depth to rock. | Moderate: slope, depth to rock. | Moderate: depth to rock, frost action. | Moderate: thin layer. |
| McA---------- Manawa | Severe: wetness, too clayey, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: floods, low strength, wetness. | Moderate: wetness, floods. |
| MeB---------- Manistee | Moderate: too clayey. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. | Slight--------- | Moderate: too sandy. |
| Mk---------- Markey | Severe: wetness, floods, cutbanks cave. | Severe: floods, wetness, low strength. | Severe: floods, wetness, low strength. | Severe: floods, wetness, low strength. | Severe: low strength, wetness, floods. | Severe: excess humus, wetness, floods. |
| MmA---------- Matherton | Severe: wetness, cutbanks cave. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: frost action, low strength, wetness. | Moderate: wetness. |
| MrB---------- Menominee | Slight--------- | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: frost action, low strength. | Moderate: too sandy. |
| MsB---------- Menominee Variant | Severe: cutbanks cave. | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: too sandy. |
| MtA---------- Mosel | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: frost action, low strength, floods. | Severe: floods. |
| My---------- Mussey | Severe: cutbanks cave, floods, wetness. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: floods, wetness, frost action. | Severe: wetness. |
| NaB---------- Namur | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: thin layer. |
| NrD*: Namur---------- | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock, slope. | Severe: depth to rock. | Severe: thin layer. |
| Rock outcrop. | | | | | | |
| NxB---------- Nichols | Severe: cutbanks cave. | Slight--------- | Slight--------- | Slight--------- | Severe: frost action. | Slight. |
| OaB---------- Oakville | Severe: cutbanks cave. | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: too sandy. |
| OaC---------- Oakville | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: too sandy, slope. |
| OdB---------- Omro | Moderate: too clayey. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| OeC2---------- Omro | Moderate: too clayey, slope. | Moderate: shrink-swell, slope. | Moderate: shrink-swell, slope. | Severe: slope. | Severe: low strength. | Moderate: slope. |

See footnote at end of table.

TABLE 10.--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 |
|---|---|---|---|---|---|---|
| OhB---------- Onaway | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: low strength, frost action. | Slight. |
| OhC2---------- Onaway | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: low strength, slope, frost action. | Moderate: slope. |
| Pe---------- Pella | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods, low strength. | Severe: wetness. |
| Pg*. Pits | | | | | | |
| Po---------- Poygan | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods, low strength. | Severe: wetness, floods. |
| RcE*: Rodman---------- | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope, small stones. |
| Casco---------- | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Rs---------- Roscommon | Severe: wetness, cutbanks cave, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. |
| Ru---------- Ruse | Severe: depth to rock, wetness, floods. | Severe: depth to rock, wetness, floods. | Severe: depth to rock, wetness, floods. | Severe: depth to rock, wetness, floods. | Severe: depth to rock, wetness, floods. | Severe: wetness, floods, thin layer. |
| ShA---------- Shiocton | Severe: wetness, floods, cutbanks cave. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: frost action, floods. | Moderate: wetness, floods. |
| SoA---------- Solona | Severe: wetness, floods. | Severe: floods, wetness. | Severe: wetness, floods. | Severe: floods, wetness. | Severe: frost action, floods. | Moderate: wetness, floods. |
| SyA---------- Symco | Severe: wetness, floods. | Severe: floods, wetness. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: frost action, low strength, floods. | Moderate: wetness, floods. |
| Uf*. Udifluvents | | | | | | |
| UoB*, UoF*. Udorthents | | | | | | |
| WaA---------- Wainola | Severe: wetness, cutbanks cave. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Moderate: wetness, frost action. | Moderate: too sandy, wetness. |
| We---------- Wauseon | Severe: wetness, cutbanks cave. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, frost action. | Severe: wetness. |

See footnote at end of table.

TABLE 10.--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 |
|---|---|---|---|---|---|---|
| WoB---------- Waymor | Slight--------- | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| WoC2---------- Waymor | Moderate: slope. | Moderate: slope, shrink-swell. | Moderate: slope, shrink-swell. | Severe: slope. | Severe: low strength. | Moderate: slope. |
| WoD2---------- Waymor | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope, low strength. | Severe: slope. |
| WzB*: | | | | | | |
| Waymor---------- | Slight--------- | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| Casco---------- | Severe: cutbanks cave. | Slight--------- | Slight--------- | Slight--------- | Moderate: frost action. | Slight. |
| Zurich---------- | Severe: cutbanks cave. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: frost action, low strength. | Slight. |
| WzC2*: | | | | | | |
| Waymor---------- | Moderate: slope. | Moderate: slope, shrink-swell. | Moderate: slope, shrink-swell. | Severe: slope. | Severe: low strength. | Moderate: slope. |
| Casco---------- | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope, frost action. | Moderate: slope. |
| Zurich---------- | Severe: cutbanks cave. | Moderate: slope, shrink-swell. | Moderate: slope, shrink-swell. | Severe: slope. | Severe: frost action, low strength. | Moderate: slope. |
| WzD*, WzE*: | | | | | | |
| Waymor---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope, low strength. | Severe: slope. |
| Casco---------- | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Zurich---------- | Severe: slope, cutbanks cave. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: frost action, slope, low strength. | Severe: slope. |
| ZuA---------- Zurich | Severe: cutbanks cave. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: frost action, low strength. | Slight. |
| ZuB---------- Zurich | Severe: cutbanks cave. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell, slope. | Severe: frost action, low strength. | Slight. |
| ZuC2---------- Zurich | Severe: cutbanks cave. | Moderate: slope, shrink-swell. | Moderate: slope, shrink-swell. | Severe: slope. | Severe: frost action, low strength. | Moderate: slope. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--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 |
|---|---|---|---|---|---|
| AdA<br>Allendale | Severe:<br>wetness,<br>percs slowly. | Severe:<br>wetness,<br>seepage. | Severe:<br>wetness,<br>too clayey. | Severe:<br>wetness,<br>seepage. | Poor:<br>too clayey,<br>wetness. |
| Ax<br>Angelica | Severe:<br>wetness,<br>floods,<br>percs slowly. | Severe:<br>wetness. | Severe:<br>wetness,<br>floods. | Severe:<br>wetness,<br>floods. | Poor:<br>wetness. |
| Ba<br>Bach | Severe:<br>wetness,<br>floods. | Severe:<br>wetness,<br>floods. | Severe:<br>wetness,<br>floods. | Severe:<br>wetness,<br>floods. | Poor:<br>wetness. |
| Bn<br>Bonduel | Severe:<br>wetness,<br>depth to rock. | Severe:<br>wetness,<br>depth to rock. | Severe:<br>depth to rock,<br>wetness. | Severe:<br>wetness. | Poor:<br>wetness,<br>area reclaim. |
| Bo*.<br>Borosaprists | | | | | |
| BrB<br>Boyer | Slight** | Severe:<br>seepage. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>seepage. |
| BrC<br>Boyer | Moderate**:<br>slope. | Severe:<br>seepage,<br>slope. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>seepage. |
| BrE<br>Boyer | Severe**:<br>slope. | Severe:<br>seepage,<br>slope. | Severe:<br>seepage,<br>slope,<br>too sandy. | Severe:<br>seepage,<br>slope. | Poor:<br>slope,<br>too sandy,<br>seepage. |
| Ca<br>Carbondale | Severe:<br>wetness,<br>floods,<br>subsides. | Severe:<br>wetness,<br>excess humus,<br>seepage. | Severe:<br>wetness,<br>floods,<br>seepage. | Severe:<br>wetness,<br>floods,<br>seepage. | Poor:<br>excess humus,<br>wetness. |
| CbA, CbB<br>Casco | Slight** | Severe:<br>seepage. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>seepage. |
| CbC2<br>Casco | Moderate**:<br>slope. | Severe:<br>seepage,<br>slope. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>seepage. |
| CdB*:<br>Casco | Slight** | Severe:<br>seepage. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>seepage. |
| Rodman | Slight** | Severe:<br>seepage. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>small stones. |
| CdC2*:<br>Casco | Moderate**:<br>slope. | Severe:<br>seepage,<br>slope. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>seepage. |
| Rodman | Moderate**:<br>slope. | Severe:<br>seepage,<br>slope. | Severe:<br>seepage,<br>too sandy. | Severe:<br>seepage. | Poor:<br>too sandy,<br>small stones. |

See footnote at end of table.

TABLE 11.--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 |
|---|---|---|---|---|---|
| CdD2*: Casco | Severe**: slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: slope, seepage. | Poor: slope, too sandy, seepage. |
| Rodman | Severe**: slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: seepage, slope. | Poor: too sandy, slope, small stones. |
| Cm Cathro | Severe: wetness, floods, percs slowly. | Severe: wetness, excess humus, seepage. | Severe: wetness, floods, excess humus. | Severe: wetness, floods, seepage. | Poor: excess humus, wetness. |
| DrA, DrB Dresden | Slight** | Severe: seepage. | Severe: seepage. | Severe: seepage. | Poor: too sandy, seepage, small stones. |
| FaA Fabius | Severe: wetness. | Severe: seepage, wetness. | Severe: seepage, wetness. | Severe: seepage, wetness. | Poor: too sandy, small stones, wetness. |
| Fu*. Fluvaquents | | | | | |
| HrB Hortonville | Moderate: percs slowly. | Moderate: slope, seepage. | Moderate: too clayey. | Slight | Fair: too clayey. |
| HrC2 Hortonville | Moderate: percs slowly, slope. | Severe: slope. | Moderate: too clayey, slope. | Moderate: slope. | Fair: too clayey, slope. |
| HrD2 Hortonville | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: too clayey, slope. |
| HsB*: Hortonville | Moderate: percs slowly. | Moderate: slope, seepage. | Moderate: too clayey. | Slight | Fair: too clayey. |
| Symco | Severe: wetness, percs slowly, floods. | Severe: wetness. | Severe: wetness, floods. | Severe: wetness, floods. | Poor: wetness. |
| HzB*: Hortonville | Moderate: percs slowly. | Moderate: slope, seepage. | Moderate: too clayey. | Slight | Fair: too clayey. |
| Boyer | Slight** | Severe: seepage. | Severe: seepage, too sandy. | Severe: seepage. | Poor: too sandy, seepage. |
| Zurich | Moderate: percs slowly. | Severe: seepage. | Severe: seepage. | Severe: seepage. | Good. |
| HzC2*: Hortonville | Moderate: percs slowly, slope. | Severe: slope. | Moderate: too clayey, slope. | Moderate: slope. | Fair: too clayey, slope. |

See footnote at end of table.

TABLE 11.--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 |
|---|---|---|---|---|---|
| HzC2*: | | | | | |
| Boyer | Moderate**: slope. | Severe: seepage, slope. | Severe: seepage, too sandy. | Severe: seepage. | Poor: too sandy, seepage. |
| Zurich | Moderate: slope, percs slowly. | Severe: slope, seepage. | Severe: seepage. | Severe: seepage. | Fair: slope. |
| HzD2*, HzE*: | | | | | |
| Hortonville | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: too clayey, slope. |
| Boyer | Severe**: slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: seepage, slope. | Poor: slope, too sandy, seepage. |
| Zurich | Severe: slope. | Severe: slope, seepage. | Severe: seepage, slope. | Severe: slope, seepage. | Poor: slope. |
| KhB, KpB2 Kewaunee | Severe: percs slowly. | Moderate: slope. | Severe: too clayey. | Slight | Poor: too clayey. |
| KpC2 Kewaunee | Severe: percs slowly. | Severe: slope. | Severe: too clayey. | Moderate: slope. | Poor: too clayey. |
| KpD2 Kewaunee | Severe: percs slowly, slope. | Severe: slope. | Severe: slope, too clayey. | Severe: slope. | Poor: too clayey, slope. |
| KsC3 Kewaunee | Severe: percs slowly. | Severe: slope. | Severe: too clayey. | Moderate: slope. | Poor: too clayey. |
| KsD3, KsE3 Kewaunee | Severe: percs slowly, slope. | Severe: slope. | Severe: slope, too clayey. | Severe: slope. | Poor: too clayey, slope. |
| KtB*: | | | | | |
| Kewaunee | Severe: percs slowly. | Moderate: slope. | Severe: too clayey. | Slight | Poor: too clayey. |
| Manawa | Severe: wetness, percs slowly, floods. | Moderate: slope. | Severe: wetness, too clayey, floods. | Severe: wetness, floods. | Poor: too clayey, wetness. |
| KuA Kibbie | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Poor: wetness. |
| KvA Kibbie Variant | Severe: floods, wetness. | Slight | Severe: floods, wetness. | Severe: floods, wetness. | Poor: wetness. |
| KwB Kolberg | Severe: depth to rock, percs slowly. | Severe: depth to rock. | Severe: depth to rock, too clayey. | Moderate: depth to rock. | Poor: area reclaim, too clayey. |
| KwC2 Kolberg | Severe: depth to rock, percs slowly. | Severe: depth to rock, slope. | Severe: depth to rock, too clayey. | Moderate: slope, depth to rock. | Poor: area reclaim, too clayey. |
| KxB Kolberg Variant | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Poor: area reclaim. |

See footnote at end of table.

TABLE 11.--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 |
|---|---|---|---|---|---|
| LmA---------- Lamartine | Severe: wetness, floods. | Severe: wetness, seepage. | Severe: wetness, floods, seepage. | Severe: wetness, floods, seepage. | Poor: wetness. |
| LoB---------- Longrie | Severe: depth to rock. | Severe: depth to rock, seepage. | Severe: depth to rock, seepage. | Severe: seepage. | Poor: area reclaim. |
| McA---------- Manawa | Severe: wetness, percs slowly, floods. | Slight---------- | Severe: wetness, too clayey, floods. | Severe: wetness, floods. | Poor: too clayey, wetness. |
| MeB---------- Manistee | Severe: percs slowly. | Moderate: slope. | Severe: too clayey. | Severe: seepage. | Poor: too clayey. |
| Mk---------- Markey | Severe: floods, wetness, subsides. | Severe: seepage, wetness, excess humus. | Severe: floods, seepage, wetness. | Severe: floods, seepage, wetness. | Poor: excess humus, wetness. |
| MmA---------- Matherton | Severe: wetness. | Severe: wetness, seepage. | Severe: wetness, seepage. | Severe: wetness, seepage. | Poor: wetness. |
| MrB---------- Menominee | Slight---------- | Moderate: slope, seepage. | Slight---------- | Severe: seepage. | Poor: too sandy, seepage. |
| MsB---------- Menominee Variant | Slight**--------- | Severe: seepage. | Severe: seepage, too sandy. | Severe: seepage. | Poor: seepage, too sandy. |
| MtA---------- Mosel | Severe: wetness, percs slowly, floods. | Severe: wetness. | Severe: wetness, floods, too clayey. | Severe: wetness, floods. | Poor: too clayey, wetness. |
| My---------- Mussey | Severe: wetness, floods. | Severe: seepage, wetness. | Severe: seepage, floods, wetness. | Severe: floods, wetness, seepage. | Poor: seepage, wetness, too sandy. |
| NaB---------- Namur | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Poor: area reclaim. |
| NrD*: Namur---------- | Severe: depth to rock. | Severe: depth to rock, slope. | Severe: depth to rock. | Severe: depth to rock. | Poor: area reclaim. |
| Rock outcrop. | | | | | |
| NxB---------- Nichols | Moderate: percs slowly. | Moderate: slope, seepage. | Slight---------- | Slight---------- | Good. |
| OaB---------- Oakville | Slight**--------- | Severe: seepage. | Severe: seepage, too sandy. | Severe: seepage. | Poor: too sandy, seepage. |
| OaC---------- Oakville | Moderate**: slope. | Severe: seepage, slope. | Severe: seepage, too sandy. | Severe: seepage. | Poor: too sandy, seepage. |

See footnote at end of table.

TABLE 11.--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 |
|---|---|---|---|---|---|
| OdB---- Omro | Severe: percs slowly. | Moderate: seepage, slope. | Slight---- | Slight---- | Poor: too clayey. |
| OeC2---- Omro | Severe: percs slowly. | Severe: slope. | Moderate: slope. | Moderate: slope. | Poor: too clayey. |
| OhB---- Onaway | Moderate: percs slowly. | Moderate: seepage, slope. | Slight---- | Slight---- | Good. |
| OhC2---- Onaway | Moderate: percs slowly, slope. | Severe: slope. | Moderate: slope. | Moderate: slope. | Fair: slope. |
| Pe---- Pella | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Severe: wetness, floods. | Poor: wetness. |
| Pg*. Pits | | | | | |
| Po---- Poygan | Severe: wetness, percs slowly, floods. | Slight---- | Severe: wetness, floods, too clayey. | Severe: wetness, floods. | Poor: wetness, too clayey. |
| RcE*: Rodman---- | Severe**: slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: seepage, slope. | Poor: too sandy, slope, small stones. |
| Casco---- | Severe**: slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: slope, seepage. | Poor: slope, too sandy, seepage. |
| Rs---- Roscommon | Severe: wetness, floods. | Severe: wetness, seepage, floods. | Severe: wetness, seepage, floods. | Severe: wetness, seepage, floods. | Poor: wetness, too sandy, seepage. |
| Ru---- Ruse | Severe: depth to rock, wetness, floods. | Severe: depth to rock, wetness. | Severe: depth to rock, wetness, floods. | Severe: wetness, floods. | Poor: wetness, area reclaim. |
| ShA---- Shiocton | Severe: wetness, floods. | Severe: wetness. | Severe: wetness, floods. | Severe: floods, wetness. | Poor: wetness. |
| SoA---- Solona | Severe: wetness, floods. | Severe: wetness, floods. | Severe: floods, wetness. | Severe: floods, wetness. | Poor: wetness. |
| SyA---- Symco | Severe: wetness, percs slowly, floods. | Severe: wetness. | Severe: wetness, floods. | Severe: wetness, floods. | Poor: wetness. |
| Uf*. Udifluvents | | | | | |
| UoB*, UoF*. Udorthents | | | | | |

See footnote at end of table.

TABLE 11.--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 |
|---|---|---|---|---|---|
| WaA---------- Wainola | Severe: wetness. | Severe: seepage, wetness. | Severe: wetness, seepage. | Severe: wetness, seepage. | Poor: seepage, too sandy. |
| We---------- Wauseon | Severe: percs slowly, wetness. | Severe: seepage, wetness. | Severe: wetness, too clayey. | Severe: wetness, seepage. | Poor: wetness, too clayey. |
| WoB---------- Waymor | Slight---------- | Moderate: slope, seepage. | Slight---------- | Slight---------- | Good. |
| WoC2---------- Waymor | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. | Fair: slope. |
| WoD2---------- Waymor | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: slope. |
| WzB*: | | | | | |
| Waymor---------- | Slight---------- | Moderate: slope, seepage. | Slight---------- | Slight---------- | Good. |
| Casco---------- | Slight**--------- | Severe: seepage. | Severe: seepage, too sandy. | Severe: seepage. | Poor: too sandy, seepage. |
| Zurich---------- | Moderate: percs slowly. | Severe: seepage. | Severe: seepage. | Severe: seepage. | Good. |
| WzC2*: | | | | | |
| Waymor---------- | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. | Fair: slope. |
| Casco---------- | Moderate**: slope. | Severe: seepage, slope. | Severe: seepage, too sandy. | Severe: seepage. | Poor: too sandy, seepage. |
| Zurich---------- | Moderate: slope, percs slowly. | Severe: slope, seepage. | Severe: seepage. | Severe: seepage. | Fair: slope. |
| WzD*, WzE*: | | | | | |
| Waymor---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: slope. |
| Casco---------- | Severe**: slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: slope, seepage. | Poor: slope, too sandy, seepage. |
| Zurich---------- | Severe: slope. | Severe: slope, seepage. | Severe: seepage, slope. | Severe: slope, seepage. | Poor: slope. |
| ZuA, ZuB---------- Zurich | Moderate: percs slowly. | Severe: seepage. | Severe: seepage. | Severe: seepage. | Good. |
| ZuC2---------- Zurich | Moderate: slope, percs slowly. | Severe: slope, seepage. | Severe: seepage. | Severe: seepage. | Fair: slope. |

* See description of the map unit for composition and behavior characteristics of the map unit.

** Excessive permeability rate may cause pollution of ground water.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| AdA<br>Allendale | Poor:<br>low strength,<br>shrink-swell,<br>wetness. | Poor:<br>thin layer. | Unsuited:<br>excess fines. | Poor:<br>wetness. |
| Ax<br>Angelica | Poor:<br>wetness. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>wetness. |
| Ba<br>Bach | Poor:<br>wetness. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>wetness. |
| Bn<br>Bonduel | Poor:<br>wetness,<br>thin layer,<br>area reclaim. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer,<br>area reclaim. |
| Bo*.<br>Borosaprists | | | | |
| BrB<br>Boyer | Good | Good | Good | Fair:<br>too sandy. |
| BrC<br>Boyer | Good | Good | Good | Fair:<br>too sandy,<br>slope. |
| BrE<br>Boyer | Poor:<br>slope. | Good | Good | Poor:<br>slope. |
| Ca<br>Carbondale | Poor:<br>low strength,<br>wetness. | Unsuited:<br>excess humus. | Unsuited:<br>excess humus. | Poor:<br>excess humus,<br>wetness. |
| CbA, CbB<br>Casco | Good | Good | Good | Fair:<br>thin layer. |
| CbC2<br>Casco | Good | Good | Good | Fair:<br>thin layer,<br>slope. |
| CdB*:<br>Casco | Good | Good | Good | Fair:<br>thin layer. |
| Rodman | Good | Good | Good | Poor:<br>small stones. |
| CdC2*:<br>Casco | Good | Good | Good | Fair:<br>thin layer,<br>slope. |
| Rodman | Good | Good | Good | Poor:<br>small stones. |
| CdD2*:<br>Casco | Fair:<br>slope. | Good | Good | Poor:<br>slope. |
| Rodman | Fair:<br>slope. | Good | Good | Poor:<br>small stones,<br>slope. |

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| Cm---------- Cathro | Poor: excess humus, wetness. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: wetness, excess humus. |
| DrA, DrB---------- Dresden | Good---------- | Good---------- | Good---------- | Fair: thin layer. |
| FaA---------- Fabius | Poor: wetness. | Good---------- | Good---------- | Fair: thin layer, small stones. |
| Fu*. Fluvaquents | | | | |
| HrB---------- Hortonville | Fair: low strength, shrink-swell. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| HrC2---------- Hortonville | Fair: low strength, shrink-swell. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer, slope. |
| HrD2---------- Hortonville | Fair: low strength, shrink-swell, slope. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: slope. |
| HsB*: Hortonville---------- | Fair: low strength, shrink-swell. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| Symco---------- | Poor: low strength, wetness. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer, small stones. |
| HzB*: Hortonville---------- | Fair: low strength, shrink-swell. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| Boyer---------- | Good---------- | Good---------- | Good---------- | Fair: too sandy. |
| Zurich---------- | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| HzC2*: Hortonville---------- | Fair: low strength, shrink-swell. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer, slope. |
| Boyer---------- | Good---------- | Good---------- | Good---------- | Fair: too sandy, slope. |
| Zurich---------- | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Fair: thin layer, slope. |
| HzD2*: Hortonville---------- | Fair: low strength, shrink-swell, slope. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: slope. |
| Boyer---------- | Fair: slope. | Good---------- | Good---------- | Poor: slope. |

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| HzD2*: | | | | |
| Zurich | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Poor: slope. |
| HzE*: | | | | |
| Hortonville | Poor: slope. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: slope. |
| Boyer | Poor: slope. | Good | Good | Poor: slope. |
| Zurich | Poor: low strength, slope. | Poor: excess fines. | Unsuited: excess fines. | Poor: slope. |
| KhB<br>Kewaunee | Poor: low strength. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| KpB2, KpC2<br>Kewaunee | Poor: low strength. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: too clayey. |
| KpD2<br>Kewaunee | Poor: low strength. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: slope. |
| KsC3<br>Kewaunee | Poor: low strength. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: too clayey. |
| KsD3<br>Kewaunee | Poor: low strength. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: slope. |
| KsE3<br>Kewaunee | Poor: low strength, slope. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: slope. |
| KtB*: | | | | |
| Kewaunee | Poor: low strength. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| Manawa | Poor: low strength, wetness. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| KuA<br>Kibbie | Poor: wetness. | Unsuited: excess fines. | Unsuited: excess fines. | Good. |
| KvA<br>Kibbie Variant | Poor: wetness. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| KwB<br>Kolberg | Poor: low strength, area reclaim, thin layer. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer, area reclaim. |
| KwC2<br>Kolberg | Poor: low strength, area reclaim, thin layer. | Unsuited: excess fines. | Unsuited: excess fines. | Fair: thin layer, slope, area reclaim. |
| KxB<br>Kolberg Variant | Poor: low strength, thin layer, area reclaim. | Unsuited: excess fines. | Unsuited: excess fines. | Poor: area reclaim. |
| LmA<br>Lamartine | Fair: low strength. | Poor: excess fines. | Poor: excess fines. | Fair: thin layer. |

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| LoB<br>Longrie | Poor:<br>thin layer,<br>area reclaim. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>area reclaim,<br>small stones. |
| McA<br>Manawa | Poor:<br>low strength,<br>wetness. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |
| MeB<br>Manistee | Poor:<br>low strength,<br>shrink-swell. | Poor:<br>thin layer. | Unsuited:<br>excess fines. | Fair:<br>too sandy. |
| Mk<br>Markey | Poor:<br>low strength,<br>wetness. | Good | Unsuited:<br>excess fines,<br>excess humus. | Poor:<br>excess humus,<br>wetness. |
| MmA<br>Matherton | Poor:<br>wetness. | Good | Good | Fair:<br>thin layer. |
| MrB<br>Menominee | Fair:<br>low strength. | Poor:<br>thin layer. | Unsuited:<br>excess fines. | Poor:<br>too sandy. |
| MsB<br>Menominee Variant | Good | Fair:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>too sandy. |
| MtA<br>Mosel | Poor:<br>low strength,<br>wetness. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |
| My<br>Mussey | Poor:<br>wetness. | Good | Good | Poor:<br>wetness. |
| NaB<br>Namur | Poor:<br>thin layer,<br>area reclaim. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>thin layer,<br>area reclaim. |
| NrD*:<br>Namur | Poor:<br>thin layer,<br>area reclaim. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>thin layer,<br>area reclaim. |
| Rock outcrop. | | | | |
| NxB<br>Nichols | Fair:<br>low strength. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Good. |
| OaB, OaC<br>Oakville | Good | Good | Unsuited:<br>excess fines. | Poor:<br>too sandy. |
| OdB<br>Omro | Poor:<br>low strength. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |
| OeC2<br>Omro | Poor:<br>low strength. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>too clayey,<br>slope. |
| OhB<br>Onaway | Fair:<br>low strength. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |
| OhC2<br>Onaway | Fair:<br>low strength. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer,<br>slope. |
| Pe<br>Pella | Poor:<br>wetness,<br>low strength. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>wetness. |

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| Pg*.<br>Pits | | | | |
| Po<br>Poygan | Poor:<br>wetness,<br>low strength. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>wetness. |
| RcE*:<br>Rodman | Poor:<br>slope. | Good | Good | Poor:<br>small stones,<br>slope. |
| Casco | Poor:<br>slope. | Good | Good | Poor:<br>slope. |
| Rs<br>Roscommon | Poor:<br>wetness. | Good | Unsuited:<br>excess fines. | Poor:<br>wetness,<br>too sandy. |
| Ru<br>Ruse | Poor:<br>thin layer,<br>wetness. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>wetness,<br>area reclaim. |
| ShA<br>Shiocton | Poor:<br>wetness. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Good. |
| SoA<br>Solona | Poor:<br>wetness. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>small stones. |
| SyA<br>Symco | Poor:<br>low strength,<br>wetness. | Unsuited:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer,<br>small stones. |
| Uf*.<br>Udifluvents | | | | |
| UoB*, UoF*.<br>Udorthents | | | | |
| WaA<br>Wainola | Poor:<br>wetness. | Good | Unsuited:<br>excess fines. | Fair:<br>too sandy. |
| We<br>Wauseon | Poor:<br>wetness,<br>low strength,<br>shrink-swell. | Poor:<br>excess fines,<br>thin layer. | Unsuited:<br>excess fines. | Poor:<br>wetness. |
| WoB<br>Waymor | Fair:<br>low strength. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |
| WoC2<br>Waymor | Fair:<br>low strength. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>slope,<br>thin layer. |
| WoD2<br>Waymor | Fair:<br>low strength,<br>slope. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Poor:<br>slope. |
| WzB*:<br>Waymor | Fair:<br>low strength. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |
| Casco | Good | Good | Good | Fair:<br>thin layer. |
| Zurich | Poor:<br>low strength. | Poor:<br>excess fines. | Unsuited:<br>excess fines. | Fair:<br>thin layer. |

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| WzC2*: | | | | |
| Waymor | Fair: low strength. | Poor: excess fines. | Unsuited: excess fines. | Fair: slope, thin layer. |
| Casco | Good | Good | Good | Fair: thin layer, slope. |
| Zurich | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Fair: thin layer, slope. |
| WzD*: | | | | |
| Waymor | Fair: low strength, slope. | Poor: excess fines. | Unsuited: excess fines. | Poor: slope. |
| Casco | Fair: slope. | Good | Good | Poor: slope. |
| Zurich | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Poor: slope. |
| WzE*: | | | | |
| Waymor | Poor: slope. | Poor: excess fines. | Unsuited: excess fines. | Poor: slope. |
| Casco | Poor: slope. | Good | Good | Poor: slope. |
| Zurich | Poor: low strength, slope. | Poor: excess fines. | Unsuited: excess fines. | Poor: slope. |
| ZuA, ZuB Zurich | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Fair: thin layer. |
| ZuC2 Zurich | Poor: low strength. | Poor: excess fines. | Unsuited: excess fines. | Fair: thin layer, slope. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

| Soil name and map symbol | Pond reservoir areas | Embankments, dikes, and levees | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| AdA---------- Allendale | Favorable------ | Wetness-------- | Percs slowly--- | Fast intake, wetness, soil blowing. | Wetness, too sandy, soil blowing. | Wetness, percs slowly. |
| Ax---------- Angelica | Favorable------ | Wetness-------- | Floods, frost action. | Wetness, floods. | Wetness-------- | Wetness. |
| Ba---------- Bach | Seepage-------- | Piping, wetness. | Frost action, floods. | Wetness-------- | Wetness-------- | Wetness. |
| Bn---------- Bonduel | Depth to rock, seepage. | Thin layer, wetness. | Depth to rock, frost action. | Wetness, rooting depth. | Wetness, depth to rock. | Wetness, depth to rock. |
| Bo*. Borosaprists | | | | | | |
| BrB---------- Boyer | Slope, seepage. | Seepage-------- | Not needed----- | Fast intake, droughty, soil blowing. | Soil blowing, too sandy. | Droughty. |
| BrC, BrE---------- Boyer | Slope, seepage. | Seepage-------- | Not needed----- | Fast intake, droughty, soil blowing. | Slope, soil blowing, too sandy. | Slope, droughty. |
| Ca---------- Carbondale | Seepage-------- | Excess humus, wetness. | Floods, excess humus, frost action. | Wetness, soil blowing, floods. | Not needed----- | Wetness. |
| CbA---------- Casco | Seepage-------- | Seepage-------- | Not needed----- | Droughty, soil blowing. | Too sandy, soil blowing. | Droughty. |
| CbB---------- Casco | Seepage, slope. | Seepage-------- | Not needed----- | Slope, droughty, soil blowing. | Too sandy, soil blowing. | Droughty. |
| CbC2---------- Casco | Seepage, slope. | Seepage-------- | Not needed----- | Slope, droughty, soil blowing. | Slope, too sandy, soil blowing. | Droughty, slope. |
| CdB*: Casco---------- | Seepage, slope. | Seepage-------- | Not needed----- | Slope, droughty, soil blowing. | Too sandy, soil blowing. | Droughty. |
| Rodman---------- | Slope, seepage. | Seepage-------- | Not needed----- | Slope, droughty. | Too sandy------ | Droughty. |
| CdC2*, CdD2*: Casco---------- | Seepage, slope. | Seepage-------- | Not needed----- | Slope, droughty, soil blowing. | Slope, too sandy, soil blowing. | Droughty, slope. |
| Rodman---------- | Slope, seepage. | Seepage-------- | Not needed----- | Slope, droughty. | Slope, too sandy. | Slope, droughty. |
| Cm---------- Cathro | Seepage-------- | Piping, wetness. | Floods, frost action. | Wetness, soil blowing, floods. | Not needed----- | Wetness. |
| DrA---------- Dresden | Seepage-------- | Seepage-------- | Not needed----- | Favorable------ | Too sandy------ | Favorable. |
| DrB---------- Dresden | Slope, seepage. | Seepage-------- | Not needed----- | Slope---------- | Too sandy------ | Favorable. |

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Pond reservoir areas | Embankments, dikes, and levees | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| FaA---------- Fabius | Seepage-------- | Seepage-------- | Frost action--- | Wetness, droughty. | Wetness, too sandy. | Droughty, wetness. |
| Fu*. Fluvaquents | | | | | | |
| HrB---------- Hortonville | Seepage, slope. | Favorable------ | Not needed----- | Slope, erodes easily. | Favorable------ | Erodes easily. |
| HrC2, HrD2-------- Hortonville | Seepage, slope. | Favorable------ | Not needed----- | Slope, erodes easily. | Slope---------- | Slope, erodes easily. |
| HsB*: Hortonville------ | Seepage, slope. | Favorable------ | Not needed----- | Slope, erodes easily. | Favorable------ | Erodes easily. |
| Symco---------- | Favorable------ | Wetness-------- | Frost action, floods. | Wetness, floods. | Wetness, erodes easily. | Wetness, erodes easily. |
| HzB*: Hortonville------ | Seepage, slope. | Favorable------ | Not needed----- | Slope, erodes easily. | Favorable------ | Erodes easily. |
| Boyer---------- | Slope, seepage. | Seepage-------- | Not needed----- | Fast intake, droughty, soil blowing. | Soil blowing, too sandy. | Droughty. |
| Zurich---------- | Slope, seepage. | Piping--------- | Not needed----- | Slope, erodes easily. | Favorable------ | Erodes easily. |
| HzC2*, HzD2*, HzE*: Hortonville----- | Seepage, slope. | Favorable------ | Not needed----- | Slope, erodes easily. | Slope---------- | Slope, erodes easily. |
| Boyer---------- | Slope, seepage. | Seepage-------- | Not needed----- | Fast intake, droughty, soil blowing. | Slope, soil blowing, too sandy. | Slope, droughty. |
| Zurich---------- | Slope, seepage. | Piping--------- | Not needed----- | Slope, erodes easily. | Slope---------- | Slope, erodes easily. |
| KhB, KpB2--------- Kewaunee | Slope---------- | Hard to pack--- | Not needed----- | Slope, percs slowly. | Percs slowly--- | Erodes easily, percs slowly. |
| KpC2, KpD2-------- Kewaunee | Slope---------- | Hard to pack--- | Not needed----- | Slope, percs slowly. | Slope, percs slowly. | Slope, erodes easily, percs slowly. |
| KsC3, KsD3, KsE3-- Kewaunee | Slope---------- | Hard to pack--- | Not needed----- | Slow intake, percs slowly, slope. | Slope, percs slowly. | Slope, erodes easily, percs slowly. |
| KtB*: Kewaunee--------- | Slope---------- | Hard to pack--- | Not needed----- | Slope, percs slowly. | Percs slowly--- | Erodes easily, percs slowly. |
| Manawa---------- | Favorable------ | Hard to pack, wetness. | Percs slowly, floods, frost action. | Percs slowly, wetness. | Wetness, percs slowly. | Wetness, percs slowly. |
| KuA---------- Kibbie | Seepage-------- | Piping, wetness. | Frost action--- | Wetness-------- | Erodes easily, wetness. | Wetness, erodes easily. |
| KvA---------- Kibbie Variant | Seepage-------- | Hard to pack, wetness. | Percs slowly, floods, frost action. | Wetness, percs slowly, floods. | Wetness, percs slowly. | Wetness, percs slowly. |

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Pond reservoir areas | Embankments, dikes, and levees | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| KwB---------- Kolberg | Slope, depth to rock. | Thin layer----- | Not needed----- | Percs slowly, erodes easily, slope. | Percs slowly, depth to rock. | Erodes easily, depth to rock. |
| KwC2---------- Kolberg | Slope, depth to rock. | Thin layer----- | Not needed----- | Percs slowly, erodes easily, slope. | Slope, percs slowly, depth to rock. | Slope, erodes easily, depth to rock. |
| KxB---------- Kolberg Variant | Slope, depth to rock. | Thin layer----- | Not needed----- | Droughty, depth to rock, slope. | Depth to rock, erodes easily. | Droughty, depth to rock. |
| LmA---------- Lamartine | Seepage-------- | Piping, wetness. | Frost action, floods. | Wetness, erodes easily. | Wetness, erodes easily. | Wetness, erodes easily. |
| LoB---------- Longrie | Seepage, depth to rock, slope. | Thin layer, piping. | Not needed----- | Rooting depth, slope. | Depth to rock | Depth to rock. |
| McA---------- Manawa | Favorable------ | Hard to pack, wetness. | Percs slowly, floods, frost action. | Percs slowly, wetness. | Wetness, percs slowly. | Wetness, percs slowly. |
| MeB---------- Manistee | Slope---------- | Hard to pack--- | Not needed----- | Fast intake, percs slowly, soil blowing. | Too sandy, soil blowing. | Percs slowly. |
| Mk---------- Markey | Seepage-------- | Seepage, wetness, excess humus. | Floods, excess humus, frost action. | Wetness, soil blowing, floods. | Not needed----- | Wetness. |
| MmA---------- Matherton | Seepage-------- | Seepage, wetness. | Frost action--- | Wetness-------- | Wetness, too sandy. | Wetness. |
| MrB---------- Menominee | Seepage, slope. | Piping--------- | Not needed----- | Slope, soil blowing. | Too sandy, soil blowing. | Favorable. |
| MsB---------- Menominee Variant | Seepage, slope. | Seepage-------- | Not needed----- | Droughty, fast intake, soil blowing. | Too sandy, soil blowing. | Droughty. |
| MtA---------- Mosel | Seepage-------- | Wetness-------- | Frost action, percs slowly, floods. | Wetness, percs slowly, floods. | Wetness, percs slowly. | Wetness, percs slowly. |
| My---------- Mussey | Seepage-------- | Seepage, wetness. | Floods, frost action. | Wetness, droughty, floods. | Wetness, too sandy. | Wetness, droughty. |
| NaB---------- Namur | Seepage, depth to rock, slope. | Thin layer----- | Not needed----- | Rooting depth, slope. | Depth to rock | Rooting depth. |
| NrD*: Namur---------- | Seepage, depth to rock, slope. | Thin layer----- | Not needed----- | Rooting depth, slope. | Slope, depth to rock. | Slope, rooting depth. |
| Rock outcrop. | | | | | | |
| NxB---------- Nichols | Seepage, slope. | Piping--------- | Not needed----- | Slope, soil blowing. | Soil blowing, erodes easily. | Erodes easily. |
| OaB---------- Oakville | Seepage, slope. | Piping, seepage. | Not needed----- | Fast intake, droughty, soil blowing. | Too sandy, soil blowing. | Droughty. |
| OaC---------- Oakville | Seepage, slope. | Piping, seepage. | Not needed----- | Fast intake, droughty, soil blowing. | Slope, too sandy, soil blowing. | Slope, droughty. |

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Pond reservoir areas | Embankments, dikes, and levees | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| OdB---------- Omro | Seepage, slope. | Hard to pack--- | Not needed----- | Percs slowly, erodes easily, slope. | Erodes easily, percs slowly. | Erodes easily, percs slowly. |
| OeC2---------- Omro | Seepage, slope. | Hard to pack--- | Not needed----- | Percs slowly, slope. | Slope, percs slowly. | Slope, percs slowly. |
| OhB---------- Onaway | Seepage, slope. | Favorable------ | Not needed----- | Slope---------- | Favorable------ | Favorable. |
| OhC2---------- Onaway | Seepage, slope. | Favorable------ | Not needed----- | Slope---------- | Slope---------- | Slope. |
| Pe---------- Pella | Seepage-------- | Wetness-------- | Floods, frost action. | Wetness, floods. | Wetness-------- | Wetness. |
| Pg*. Pits | | | | | | |
| Po---------- Poygan | Favorable------ | Hard to pack, wetness. | Percs slowly, floods, frost action. | Wetness, percs slowly, floods. | Wetness, percs slowly. | Wetness, percs slowly. |
| RcE*: Rodman---------- | Slope, seepage. | Seepage-------- | Not needed----- | Slope, droughty. | Slope, too sandy. | Slope, droughty. |
| Casco---------- | Seepage, slope. | Seepage-------- | Not needed----- | Slope, droughty, soil blowing. | Slope, too sandy, soil blowing. | Droughty, slope. |
| Rs---------- Roscommon | Seepage-------- | Seepage, wetness. | Floods--------- | Wetness, droughty, fast intake. | Wetness-------- | Wetness, droughty. |
| Ru---------- Ruse | Depth to rock | Than layer, wetness. | Depth to rock, floods, frost action. | Wetness, floods, depth to rock. | Wetness, depth to rock. | Wetness, depth to rock. |
| ShA---------- Shiocton | Seepage-------- | Piping, wetness. | Floods, frost action. | Floods, wetness. | Wetness, erodes easily. | Wetness, erodes easily. |
| SoA---------- Solona | Seepage-------- | Piping, wetness. | Floods, frost action. | Floods, wetness. | Wetness-------- | Wetness. |
| SyA---------- Symco | Favorable------ | Wetness-------- | Frost action, floods. | Wetness, floods. | Wetness, erodes easily. | Wetness, erodes easily. |
| Uf*. Udifluvents | | | | | | |
| UoB*, UoF*. Udorthents | | | | | | |
| WaA---------- Wainola | Seepage-------- | Piping, seepage. | Favorable------ | Droughty, fast intake, soil blowing. | Wetness, too sandy, soil blowing. | Wetness, droughty. |
| We---------- Wauseon | Seepage-------- | Wetness, hard to pack. | Percs slowly, frost action. | Wetness, soil blowing. | Wetness, soil blowing, percs slowly. | Wetness, percs slowly. |
| WoB---------- Waymor | Seepage-------- | Favorable------ | Not needed----- | Slope, erodes easily. | Erodes easily | Erodes easily. |
| WoC2, WoD2-------- Waymor | Seepage, slope. | Favorable------ | Not needed----- | Slope, erodes easily. | Slope, erodes easily. | Erodes easily, slope. |

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Pond reservoir areas | Embankments, dikes, and levees | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| WzB*: | | | | | | |
| Waymor | Seepage | Favorable | Not needed | Slope, erodes easily. | Erodes easily | Erodes easily. |
| Casco | Seepage, slope. | Seepage | Not needed | Slope, droughty, soil blowing. | Too sandy, soil blowing. | Droughty. |
| Zurich | Slope, seepage. | Piping | Not needed | Slope, erodes easily. | Favorable | Erodes easily. |
| WzC2*, WzD*, WzE*: | | | | | | |
| Waymor | Seepage, slope. | Favorable | Not needed | Slope, erodes easily. | Slope, erodes easily. | Erodes easily; slope. |
| Casco | Seepage, slope. | Seepage | Not needed | Slope, droughty, soil blowing. | Slope, too sandy, soil blowing. | Droughty, slope. |
| Zurich | Slope, seepage. | Piping | Not needed | Slope, erodes easily. | Slope | Slope, erodes easily. |
| ZuA Zurich | Seepage | Piping | Not needed | Erodes easily | Favorable | Erodes easily. |
| ZuB Zurich | Slope, seepage. | Piping | Not needed | Slope, erodes easily. | Favorable | Erodes easily. |
| ZuC2 Zurich | Slope, seepage. | Piping | Not needed | Slope, erodes easily. | Slope | Slope, erodes easily. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--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 | | Fragments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| AdA----------<br>Allendale | 0-9 | Loamy fine sand | SM | A-2-4 | 0 | 100 | 95-100 | 50-75 | 15-25 | --- | NP |
| | 9-26 | Sand, sandy loam, fine sand. | SP, SM, SP-SM | A-2-4, A-3 | 0 | 100 | 95-100 | 50-70 | 0-20 | --- | NP |
| | 26-60 | Silty clay, clay | CH, MH | A-7 | 0 | 100 | 90-100 | 90-100 | 75-95 | 50-70 | 20-40 |
| Ax----------<br>Angelica | 0-13 | Silt loam------- | ML | A-4, A-6 | 0-10 | 90-100 | 85-100 | 80-100 | 55-90 | 25-40 | 2-13 |
| | 13-21 | Loam, sandy loam, clay loam. | SM, ML, SC, CL | A-4, A-6 | 0-10 | 90-100 | 85-100 | 50-90 | 36-90 | 12-40 | 2-20 |
| | 21-60 | Loam, sandy loam, gravelly loam. | ML, SM, CL, SC | A-2-4, A-4, A-6, A-2-6 | 0-15 | 85-100 | 80-100 | 50-100 | 30-90 | 20-40 | NP-16 |
| Ba----------<br>Bach | 0-10 | Silt loam------- | ML, CL, CL-ML | A-4, A-6 | 0 | 100 | 100 | 85-100 | 65-90 | 20-35 | 2-12 |
| | 10-60 | Very fine sandy loam, silt, very fine sand. | ML, SM | A-2-4, A-4 | 0 | 100 | 80-100 | 70-95 | 25-95 | <35 | NP-4 |
| Bn----------<br>Bonduel | 0-7 | Loam---------- | ML, CL, CL-ML | A-4 | 0 | 100 | 100 | 85-100 | 60-90 | 20-30 | 3-10 |
| | 7-20 | Loam, silt loam | CL, CL-ML | A-4, A-6 | 0-2 | 90-100 | 90-100 | 80-100 | 55-90 | 20-30 | 5-12 |
| | 20-30 | Loam, fine sandy loam, sandy loam. | CL, CL-ML, SC, SM-SC | A-4, A-6 | 0-5 | 70-90 | 70-90 | 55-85 | 35-70 | 20-30 | 5-12 |
| | 30-60 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bo*.<br>Borosaprists | | | | | | | | | | | |
| BrB, BrC, BrE------<br>Boyer | 0-26 | Loamy sand------ | SM, SM-SC | A-2, A-1 | 0-5 | 95-100 | 65-95 | 45-75 | 15-30 | <20 | NP-6 |
| | 26-36 | Sandy loam, loam, gravelly sandy loam. | SM, SC, SM-SC, SP-SM | A-2, A-4, A-6 | 0-5 | 80-100 | 65-95 | 55-85 | 10-45 | 10-35 | NP-16 |
| | 36-60 | Stratified sand to gravel. | SP, SP-SM, GP, GP-GM | A-1, A-3, A-2-4 | 0-10 | 40-100 | 35-100 | 30-70 | 0-10 | --- | NP |
| Ca----------<br>Carbondale | 0-27 | Sapric material | PT | A-8 | 0 | --- | --- | --- | --- | --- | --- |
| | 27-60 | Hemic material | PT | A-8 | 0 | --- | --- | --- | --- | --- | --- |
| CbA, CbB, CbC2-----<br>Casco | 0-7 | Sandy loam------ | SM, SM-SC, ML, CL-ML | A-4, A-2 | 0 | 95-100 | 90-100 | 40-75 | 25-55 | <20 | 2-7 |
| | 7-18 | Clay loam, loam, sandy clay loam. | SC, CL | A-6, A-7 | 0-5 | 60-100 | 55-100 | 55-90 | 35-70 | 25-45 | 11-25 |
| | 18-60 | Sand and gravel | GP, SP, GP-GM, SP-SM | A-1, A-3, A-2 | 0-10 | 30-100 | 30-90 | 10-90 | 3-10 | --- | NP |

See footnote at end of table.

TABLE 14.--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 | |
| CdB*, CdC2*, CdD2*: | | | | | | | | | | | |
| Casco | 0-7 | Sandy loam | SM, SM-SC, ML, CL-ML | A-4, A-2 | 0 | 95-100 | 90-100 | 40-75 | 25-55 | <20 | 2-7 |
| | 7-18 | Clay loam, loam, sandy clay loam. | SC, CL | A-6, A-7 | 0-5 | 60-100 | 55-100 | 55-90 | 35-70 | 25-45 | 11-25 |
| | 18-60 | Sand and gravel | GP, SP, GP-GM, SP-SM | A-1, A-3, A-2 | 0-10 | 30-100 | 30-90 | 10-90 | 3-10 | --- | NP |
| Rodman | 0-9 | Gravelly sandy loam. | SM-SC, SM | A-1, A-2, A-4 | 0-2 | 70-85 | 65-85 | 40-60 | 20-40 | <25 | NP-5 |
| | 9-60 | Stratified sand to gravelly sand. | SP, SP-SM, GP, GP-GM | A-1 | 1-5 | 30-70 | 22-55 | 7-20 | 2-10 | --- | NP |
| Cm | 0-25 | Sapric material | PT | A-8 | 0 | --- | --- | --- | --- | --- | --- |
| Cathro | 25-60 | Loam, silt loam, silty clay loam. | SM, ML, SC, CL | A-4 | 0 | 100 | 95-100 | 60-100 | 35-90 | 15-26 | 3-10 |
| DrA, DrB | 0-20 | Silt loam | CL, CL-ML | A-6, A-4 | 0 | 100 | 100 | 95-100 | 85-100 | 20-40 | 5-15 |
| Dresden | 20-28 | Silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 100 | 90-100 | 90-100 | 85-95 | 30-45 | 10-25 |
| | 28-37 | Gravelly clay loam, sandy clay loam, gravelly loam. | CL, SC, GC | A-6, A-7, A-2 | 0-5 | 60-100 | 55-100 | 55-90 | 30-70 | 25-45 | 10-25 |
| | 37-60 | Sand and gravel | GP, GP-GM, SP, SP-SM | A-1 | 10-35 | 45-70 | 40-50 | 30-50 | 0-10 | --- | NP |
| FaA | 0-7 | Loam | ML | A-4 | 0-5 | 95-100 | 90-95 | 70-95 | 55-85 | 25-35 | 2-10 |
| Fabius | 7-19 | Sandy loam, sandy clay loam, loam. | SC, CL | A-4, A-6 | 0-5 | 90-95 | 70-95 | 70-90 | 40-55 | 25-40 | 8-20 |
| | 19-60 | Sand and gravel | SP, SP-SM, GP, GP-GM | A-1 | 0-5 | 50-80 | 25-75 | 10-35 | 0-10 | --- | NP |
| Fu*. Fluvaquents | | | | | | | | | | | |
| HrB, HrC2, HrD2 | 0-11 | Silt loam | ML, CL, CL-ML | A-4 | 0-5 | 95-100 | 95-100 | 85-100 | 60-90 | 20-30 | 3-10 |
| Hortonville | 11-37 | Silty clay loam, clay loam, loam. | CL, CH | A-7, A-6 | 0-5 | 85-100 | 85-100 | 80-100 | 70-90 | 35-60 | 20-37 |
| | 37-60 | Silty clay loam, clay loam, loam. | CL, SC | A-4, A-6 | 0-10 | 75-100 | 75-100 | 60-90 | 45-80 | 24-30 | 8-14 |
| HsB*: | | | | | | | | | | | |
| Hortonville | 0-11 | Silt loam | ML, CL, CL-ML | A-4 | 0-5 | 95-100 | 95-100 | 85-100 | 60-90 | 20-30 | 3-10 |
| | 11-37 | Silty clay loam, clay loam, loam. | CL, CH | A-7, A-6 | 0-5 | 85-100 | 85-100 | 80-100 | 70-90 | 35-60 | 20-37 |
| | 37-60 | Silty clay loam, clay loam, loam. | CL, SC | A-4, A-6 | 0-10 | 75-100 | 75-100 | 60-90 | 45-80 | 24-30 | 8-14 |

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification | | Fragments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| HsB*: | | | | | | | | | | | |
| Symco | 0-9 | Silt loam | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 85-100 | 60-90 | 20-30 | 3-10 |
| | 9-28 | Clay loam, silt loam, silty clay loam. | CL | A-6, A-7 | 0-5 | 85-100 | 85-95 | 75-95 | 60-90 | 30-50 | 15-30 |
| | 28-60 | Loam, clay loam, silty clay loam. | CL | A-6 | 0-5 | 85-100 | 85-95 | 75-90 | 60-85 | 25-40 | 11-20 |
| HzB*, HzC2*, HzD2*, HzE*: | | | | | | | | | | | |
| Hortonville | 0-11 | Silt loam | ML, CL, CL-ML | A-4 | 0-5 | 95-100 | 95-100 | 85-100 | 60-90 | 20-30 | 3-10 |
| | 11-37 | Silty clay loam, clay loam, loam. | CL, CH | A-7, A-6 | 0-5 | 85-100 | 85-100 | 80-100 | 70-90 | 35-60 | 20-37 |
| | 37-60 | Silty clay loam, clay loam, loam. | CL, SC | A-4, A-6 | 0-10 | 75-100 | 75-100 | 60-90 | 45-80 | 24-30 | 8-14 |
| Boyer | 0-26 | Loamy sand | SM, SM-SC | A-2, A-1 | 0-5 | 95-100 | 65-95 | 45-75 | 15-30 | <20 | NP-6 |
| | 26-36 | Sandy loam, loam, gravelly sandy loam. | SM, SC, SM-SC, SP-SM | A-2, A-4, A-6 | 0-5 | 80-100 | 65-95 | 55-85 | 10-45 | 10-35 | NP-16 |
| | 36-60 | Stratified sand to gravel. | SP, SP-SM, GP, GP-GM | A-1, A-3, A-2-4 | 0-10 | 40-100 | 35-100 | 30-70 | 0-10 | --- | NP |
| Zurich | 0-7 | Silt loam | CL-ML, CL | A-4, A-6 | 0 | 100 | 95-100 | 90-100 | 80-95 | 25-40 | 5-20 |
| | 7-27 | Silty clay loam, silt loam. | CL | A-6, A-7 | 0 | 100 | 95-100 | 90-100 | 60-90 | 30-45 | 10-25 |
| | 27-60 | Stratified silt to very fine sand. | ML, CL, SM, SC | A-2, A-4, A-6 | 0 | 90-100 | 80-100 | 70-100 | 30-95 | 20-40 | NP-20 |
| KhB<br>Kewaunee | 0-8 | Silt loam | ML, CL, CL-ML | A-4 | 0 | 95-100 | 95-100 | 85-100 | 50-90 | 20-30 | 3-10 |
| | 8-28 | Clay, silty clay, silty clay loam. | CL, CH | A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 45-70 | 30-45 |
| | 28-60 | Clay, silty clay, silty clay loam. | CL, CH | A-6, A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 30-60 | 15-35 |
| KpB2, KpC2, KpD2<br>Kewaunee | 0-7 | Silty clay loam | CL, CH | A-6, A-7 | 0 | 95-100 | 95-100 | 90-100 | 70-95 | 25-55 | 15-35 |
| | 7-27 | Clay, silty clay, silty clay loam. | CL, CH | A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 45-70 | 30-45 |
| | 27-60 | Clay, silty clay, silty clay loam. | CL, CH | A-6, A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 30-60 | 15-35 |
| KsC3, KsD3, KsE3<br>Kewaunee | 0-5 | Silty clay | CL, CH | A-6, A-7 | 0 | 95-100 | 95-100 | 90-100 | 70-95 | 25-55 | 15-35 |
| | 5-21 | Clay, silty clay, silty clay loam. | CL, CH | A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 45-70 | 30-45 |
| | 21-60 | Clay, silty clay, silty clay loam. | CL, CH | A-6, A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 30-60 | 15-35 |

See footnote at end of table.

TABLE 14.--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 | |
| KtB*: | | | | | | | | | | | |
| Kewaunee | 0-8 | Silt loam | ML, CL, CL-ML | A-4 | 0 | 95-100 | 95-100 | 85-100 | 50-90 | 20-30 | 3-10 |
| | 8-28 | Clay, silty clay, silty clay loam. | CL, CH | A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 45-70 | 30-45 |
| | 28-60 | Clay, silty clay, silty clay loam. | CL, CH | A-6, A-7 | 0-5 | 85-95 | 80-95 | 75-95 | 60-90 | 30-60 | 15-35 |
| Manawa | 0-9 | Silt loam | ML, CL, CL-ML | A-4, A-6 | 0 | 100 | 100 | 85-100 | 60-90 | 20-40 | 3-15 |
| | 9-32 | Silty clay, silty clay loam, clay. | CH, CL | A-7 | 0-5 | 90-100 | 90-100 | 85-100 | 65-95 | 45-70 | 30-45 |
| | 32-60 | Silty clay, silty clay loam, clay. | CH, CL | A-6, A-7 | 0-5 | 90-100 | 90-100 | 85-100 | 65-95 | 30-60 | 15-35 |
| KuA | 0-12 | Silt loam | ML | A-4, A-6 | 0 | 100 | 100 | 75-95 | 50-85 | 25-40 | 2-14 |
| Kibbie | 12-27 | Silt loam, sandy clay loam, loam. | CL, CL-ML, SC, SM-SC | A-4, A-6, A-7 | 0 | 90-100 | 85-100 | 80-100 | 35-90 | 25-45 | 6-25 |
| | 27-60 | Stratified silt to fine sand. | ML, SM, SC, CL | A-4, A-2 | 0 | 100 | 95-100 | 70-95 | 30-80 | <30 | NP-10 |
| KvA | 0-9 | Silt loam | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 90-100 | 70-90 | 20-30 | 3-10 |
| Kibbie Variant | 9-25 | Silty clay, silty clay loam. | CL, CH | A-7 | 0 | 100 | 100 | 95-100 | 85-95 | 40-60 | 23-35 |
| | 25-60 | Stratified silt loam to very fine sand. | ML, CL-ML | A-4 | 0 | 100 | 100 | 85-100 | 50-95 | 10-19 | 2-7 |
| KwB, KwC2 | 0-6 | Silt loam | ML, CL, CL-ML | A-4 | 0 | 100 | 100 | 85-100 | 60-90 | 20-30 | 3-10 |
| Kolberg | 6-31 | Silty clay loam, silty clay, clay. | CL, CH | A-6, A-7 | 0-2 | 70-95 | 70-95 | 65-95 | 55-90 | 35-65 | 20-35 |
| | 31-60 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| KxB | 0-8 | Silt loam | ML, CL, CL-ML | A-4 | 0 | 100 | 100 | 85-95 | 60-75 | 20-30 | 3-10 |
| Kolberg Variant | 8-18 | Clay loam, clay, silty clay. | CL | A-7 | 0 | 70-95 | 70-95 | 65-95 | 55-90 | 40-50 | 20-30 |
| | 18-60 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| LmA | 0-13 | Silt loam | ML, CL, CL-ML | A-4 | 0 | 100 | 100 | 90-100 | 70-90 | 20-30 | 3-10 |
| Lamartine | 13-21 | Silt loam, silty clay loam. | CL, CH | A-6, A-7 | 0 | 100 | 100 | 90-100 | 70-95 | 35-60 | 15-40 |
| | 21-33 | Clay loam, loam | CL, SC | A-6, A-7 | 0 | 75-100 | 75-100 | 65-95 | 45-80 | 25-50 | 11-30 |
| | 33-60 | Sandy loam, loam, gravelly fine sandy loam. | SM, ML, GM | A-4, A-2 | 0-5 | 50-90 | 40-90 | 40-80 | 25-70 | 20-30 | NP-6 |

See footnote at end of table.

TABLE 14.--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 | |
| LoB---------- Longrie | 0-7 | Loam---------- | SM, ML | A-2-4, A-4 | 0-8 | 90-95 | 85-95 | 50-95 | 25-75 | 20-40 | NP-10 |
| | 7-24 | Loam, fine sandy loam, sandy clay loam. | SM, ML, CL, SC | A-2-4, A-4, A-6, A-2-6 | 0-8 | 90-95 | 85-95 | 50-95 | 25-75 | 20-40 | 2-19 |
| | 24-28 | Loam, fine sandy loam, sandy loam. | SM, ML, CL, SC | A-2-4, A-4, A-6, A-2-6 | 0-8 | 90-95 | 85-95 | 50-95 | 25-75 | 15-27 | 3-12 |
| | 28-60 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| McA---------- Manawa | 0-9 | Silt loam------- | ML, CL, CL-ML | A-4, A-6 | 0 | 100 | 100 | 85-100 | 60-90 | 20-40 | 3-15 |
| | 9-32 | Silty clay, silty clay loam, clay. | CH, CL | A-7 | 0-5 | 90-100 | 90-100 | 85-100 | 65-95 | 45-70 | 30-45 |
| | 32-60 | Silty clay, silty clay loam, clay. | CH, CL | A-6, A-7 | 0-5 | 90-100 | 90-100 | 85-100 | 65-95 | 30-60 | 15-35 |
| MeB---------- | 0-9 | Loamy fine sand | SM | A-2-4 | 0-2 | 95-100 | 95-100 | 50-75 | 15-30 | --- | NP |
| Manistee | 9-30 | Sand, loamy sand | SP-SM, SM | A-2-4 | 0-2 | 95-100 | 95-100 | 50-75 | 10-25 | --- | NP |
| | 30-60 | Clay, silty clay | CH | A-7 | 0 | 100 | 100 | 90-100 | 80-95 | 50-80 | 25-45 |
| Mk---------- | 0-26 | Sapric material | PT | A-8 | --- | --- | --- | --- | --- | --- | --- |
| Markey | 26-60 | Sand, loamy sand | SP, SM, SP-SM | A-2, A-3 | 0 | 100 | 90-100 | 60-75 | 0-20 | --- | NP |
| MmA---------- Matherton | 0-10 | Silt loam, very fine sandy loam | ML, CL, CL-ML | A-4 | 0-5 | 95-100 | 90-100 | 85-95 | 55-90 | 20-30 | NP-8 |
| | 10-27 | Sandy clay loam, clay loam, sandy loam. | SC, CL, CL-ML, SM-SC | A-6, A-4 | 0-5 | 95-100 | 65-95 | 55-85 | 35-70 | 25-40 | 5-20 |
| | 27-60 | Sand and gravel | GP, SP, SP-SM, GP-GM | A-1, A-3, A-2-4 | 0-10 | 40-100 | 35-90 | 30-55 | 0-10 | --- | NP |
| MrB---------- | 0-7 | Loamy fine sand | SM | A-2, A-4 | 0 | 100 | 100 | 60-80 | 30-40 | --- | NP |
| Menominee | 7-28 | Sand, very fine sand, loamy sand. | SM, ML | A-2, A-4 | 0 | 100 | 100 | 65-80 | 20-60 | --- | NP |
| | 28-42 | Clay loam, loam, sandy clay loam. | SC, SM-SC, CL, CL-ML | A-4, A-6 | 0 | 95-100 | 95-100 | 80-100 | 35-80 | 20-30 | 5-15 |
| | 42-60 | Sandy loam, loam | SC, SM-SC, CL, CL-ML | A-4, A-6, A-2 | 0 | 95-100 | 95-100 | 60-95 | 30-75 | 15-30 | 5-12 |
| MsB---------- | 0-9 | Loamy fine sand | SM | A-2, A-4 | 0 | 100 | 100 | 70-85 | 30-45 | --- | NP |
| Menominee Variant | 9-32 | Fine sand------- | SM | A-2 | 0 | 100 | 95-100 | 65-80 | 20-35 | --- | NP |
| | 32-38 | Fine sandy loam, loam. | SM, SC, ML, CL | A-4, A-6 | 0-5 | 100 | 95-100 | 70-95 | 40-75 | 10-29 | 2-12 |
| | 38-60 | Gravelly sand--- | SP-SM, SM | A-1 | 5-10 | 65-85 | 65-75 | 35-45 | 5-15 | --- | NP |
| MtA---------- Mosel | 0-9 | Loam---------- | ML, CL-ML, CL | A-4 | 0 | 95-100 | 95-100 | 85-100 | 60-80 | 20-30 | 3-10 |
| | 9-20 | Loam, sandy clay loam, sandy loam. | SC, CL | A-6 | 0 | 75-100 | 75-100 | 60-100 | 35-90 | 20-40 | 9-25 |
| | 20-60 | Silty clay loam, silty clay, clay. | CL, CH | A-7, A-6 | 0-5 | 75-100 | 75-100 | 70-100 | 55-95 | 30-70 | 15-45 |

See footnote at end of table.

TABLE 14.--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 | |
| My----------<br>Mussey | 0-11 | Loam---------- | SM, SC, ML, CL | A-2, A-4 | 0-5 | 90-100 | 85-100 | 50-90 | 25-70 | 12-25 | 2-10 |
| | 11-17 | Clay loam, loam | CL, SC, CL-ML, SM-SC | A-6, A-4 | 0-10 | 80-100 | 65-100 | 50-95 | 40-80 | 20-35 | 5-15 |
| | 17-19 | Gravelly loam, gravelly sandy clay loam. | CL, SC | A-6, A-2 | 0-10 | 75-100 | 65-100 | 50-95 | 20-75 | 25-40 | 11-25 |
| | 19-60 | Sand and gravel | SP, SP-SM | A-1 | 0-10 | 55-100 | 45-100 | 0-30 | 0-10 | --- | NP |
| NaB----------<br>Namur | 0-7 | Loam---------- | ML, CL-ML, CL | A-4 | 0-5 | 90-100 | 90-100 | 85-100 | 55-90 | 20-30 | 3-10 |
| | 7-60 | Weathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NrD*:<br>Namur---------- | 0-7 | Loam---------- | ML, CL-ML, CL | A-4 | 0-5 | 90-100 | 90-100 | 85-100 | 55-90 | 20-30 | 3-10 |
| | 7-60 | Weathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rock outcrop. | | | | | | | | | | | |
| NxB----------<br>Nichols | 0-7 | Fine sandy loam | ML, CL-ML, SM, SM-SC | A-4 | 0 | 100 | 100 | 75-95 | 45-60 | <20 | 2-7 |
| | 7-27 | Very fine sandy loam, loam, silt loam. | ML, CL-ML, ML | A-4 | 0 | 100 | 100 | 85-100 | 50-90 | 15-30 | 3-10 |
| | 27-60 | Stratified very ~~fine~~ sand to silt. | ML, CL, SM, SC | A-4 | 0 | 100 | 95-100 | 80-100 | 40-95 | <25 | NP-8 |
| OaB, OaC----------<br>Oakville | 0-7 | Loamy fine sand | SM | A-2 | 0 | 100 | 100 | 55-75 | 15-25 | --- | NP |
| | 7-60 | Fine sand------- | SM, SP, SP-SM | A-2, A-3 | 0 | 100 | 95-100 | 65-95 | 0-25 | --- | NP |
| OdB----------<br>Omro | 0-6 | Silt loam------- | CL, CL-ML | A-4 | 0 | 95-100 | 95-100 | 85-100 | 65-90 | 20-30 | 5-10 |
| | 6-27 | Clay, silty clay, silty clay loam. | CH, CL | A-7 | 0-3 | 85-100 | 85-100 | 85-100 | 65-95 | 45-70 | 30-45 |
| | 27-60 | Loam, gravelly sandy loam, gravelly fine sandy loam. | SM, SM-SC, ML, CL-ML | A-4, A-2 | 0-10 | 50-95 | 50-90 | 30-85 | 15-75 | <20 | NP-7 |
| OeC2----------<br>Omro | 0-5 | Silty clay loam | CL | A-6 | 0 | 95-100 | 95-100 | 90-100 | 85-95 | 25-40 | 10-20 |
| | 5-25 | Clay, silty clay, silty clay loam. | CH, CL | A-7 | 0-3 | 85-100 | 85-100 | 85-100 | 65-95 | 45-70 | 30-45 |
| | 25-60 | Loam, gravelly sandy loam, gravelly fine sandy loam. | SM, SM-SC, ML, CL-ML | A-4, A-2 | 0-10 | 50-95 | 50-90 | 30-85 | 15-75 | <20 | NP-7 |
| OhB, OhC2----------<br>Onaway | 0-15 | Loam---------- | ML, CL-ML, CL | A-4 | 0-30 | 90-100 | 90-100 | 75-90 | 60-70 | <25 | NP-10 |
| | 15-28 | Loam, clay loam, silty clay loam. | CL, CL-ML | A-4, A-6 | 0-20 | 95-100 | 95-100 | 80-95 | 65-90 | 25-35 | 7-15 |
| | 28-60 | Silt loam, loam, sandy loam. | CL-ML, SC, CL, SM-SC | A-4 | 0-20 | 90-95 | 85-95 | 60-95 | 36-80 | 15-25 | 4-10 |

See footnote at end of table.

TABLE 14.--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 | |
| Pe | 0-14 | Silt loam | CL | A-6, A-7 | 0 | 100 | 95-100 | 85-100 | 70-95 | 25-50 | 15-30 |
| Pella | 14-27 | Silty clay loam, silt loam. | CL | A-6, A-7 | 0 | 100 | 95-100 | 85-100 | 70-95 | 30-50 | 15-30 |
| | 27-60 | Stratified sandy loam to silty clay loam. | SM-SC, SC, CL, CL-ML | A-2, A-4, A-6 | 0-5 | 90-100 | 80-100 | 50-100 | 30-85 | 20-35 | 7-20 |
| Pg*. Pits | | | | | | | | | | | |
| Po | 0-9 | Silty clay loam | CL, CH | A-7 | 0 | 100 | 100 | 90-100 | 75-95 | 45-55 | 25-35 |
| Poygan | 9-27 | Silty clay, silty clay loam, clay. | CL, CH | A-7 | 0-5 | 90-100 | 90-100 | 85-100 | 70-95 | 45-70 | 30-45 |
| | 27-60 | Clay, silty clay, silty clay loam. | CL, CH | A-7, A-6 | 0-5 | 90-100 | 90-100 | 85-100 | 70-100 | 30-70 | 15-45 |
| RcE*: | | | | | | | | | | | |
| Rodman | 0-9 | Gravelly sandy loam. | SM-SC, SM | A-1, A-2, A-4 | 0-2 | 70-85 | 65-85 | 40-60 | 20-40 | <25 | NP-5 |
| | 9-60 | Stratified sand to gravelly sand. | SP, SP-SM, GP, GP-GM | A-1 | 1-5 | 30-70 | 22-55 | 7-20 | 2-10 | --- | NP |
| Casco | 0-4 | Sandy loam | SM, SM-SC, ML, CL-ML | A-4, A-2 | 0 | 95-100 | 90-100 | 40-75 | 25-55 | <20 | 2-7 |
| | 4-12 | Clay loam, loam, sandy clay loam. | SC, CL | A-6, A-7 | 0-5 | 60-100 | 55-100 | 55-90 | 35-70 | 25-45 | 11-25 |
| | 12-60 | Sand and gravel | GP, SP, GP-GM, SP-SM | A-1, A-3, A-2 | 0-10 | 30-100 | 30-90 | 10-90 | 3-10 | --- | NP |
| Rs | 0-9 | Mucky loamy sand | SM, SP-SM | A-2, A-3 | 0 | 100 | 95-100 | 50-70 | 5-25 | --- | NP |
| Roscommon | 9-60 | Sand, loamy sand. | SP, SP-SM, SM | A-1, A-2, A-3 | 0 | 95-100 | 85-100 | 40-70 | 0-15 | --- | NP |
| Ru | 0-9 | Loam | SM, ML | A-2-4, A-4 | 0-10 | 95-100 | 90-100 | 60-95 | 30-75 | <35 | 5-10 |
| Ruse | 19-14 | Fine sandy loam, silt loam, loamy fine sand | SM, ML | A-2-4, A-4 | 0-10 | 95-100 | 90-100 | 50-95 | 20-75 | <35 | 5-10 |
| | 14-60 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ShA | 0-9 | Silt loam | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 85-100 | 60-95 | 20-30 | 3-10 |
| Shiocton | 9-25 | Silt loam, very fine sand. | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 85-100 | 50-95 | 15-30 | 3-10 |
| | 25-60 | Stratified silt to very fine sand. | ML, CL, SM, SC | A-4 | 0 | 100 | 95-100 | 80-100 | 40-95 | <25 | NP-8 |
| SoA | 0-9 | Silt loam | ML, CL, CL-ML | A-4 | 0 | 80-100 | 75-100 | 65-100 | 55-90 | 20-30 | 3-10 |
| Solona | 9-28 | Clay loam, loam | CL, SC | A-6, A-4 | 0-3 | 80-100 | 75-100 | 85-100 | 45-80 | 20-30 | 7-15 |
| | 28-60 | Loam, sandy loam | ML, CL, SM, SC | A-2, A-4 | 0-5 | 75-95 | 70-90 | 40-85 | 25-65 | <24 | NP-10 |

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification | | Fragments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| SyA---------- Symco | 0-9 | Silt loam------- | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 85-100 | 60-90 | 20-30 | 3-10 |
| | 9-28 | Clay loam, loam, silty clay loam. | CL | A-6, A-7 | 0-5 | 85-100 | 85-95 | 75-95 | 60-90 | 30-50 | 15-30 |
| | 28-60 | Loam, clay loam, silty clay loam. | CL | A-6 | 0-5 | 85-100 | 85-95 | 75-90 | 60-85 | 25-40 | 11-20 |
| Uf*. Udifluvents | | | | | | | | | | | |
| UoB*, UoF*. Udorthents | | | | | | | | | | | |
| WaA---------- Wainola | 0-9 | Loamy fine sand | SM | A-2-4 | 0 | 100 | 95-100 | 55-80 | 20-35 | --- | NP |
| | 9-29 | Fine sand, loamy fine sand. | SM | A-2-4 | 0 | 100 | 95-100 | 50-80 | 15-35 | --- | NP |
| | 29-60 | Fine sand, loamy fine sand. | SM | A-2-4 | 0 | 100 | 95-100 | 50-80 | 15-35 | --- | NP |
| We---------- Wauseon | 0-12 | Fine sandy loam | SM, ML | A-4, A-2 | 0 | 100 | 95-100 | 60-85 | 30-55 | --- | NP |
| | 12-25 | Fine sandy loam, loamy fine sand, very fine sand. | SM | A-2, A-4 | 0 | 100 | 95-100 | 65-95 | 20-45 | --- | NP |
| | 25-60 | Clay, silty clay, silty clay loam. | CH, CL, MH | A-7 | 0 | 100 | 85-100 | 90-100 | 80-95 | 42-70 | 18-36 |
| WoB, WoC2, WoD2---- Waymor | 0-15 | Silt loam------- | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 90-100 | 70-90 | 20-30 | 3-10 |
| | 15-28 | Loam, clay loam, silty clay loam. | CL | A-6, A-7 | 0 | 90-100 | 90-100 | 85-100 | 60-95 | 35-50 | 15-30 |
| | 28-38 | Loam, clay loam | CL | A-6 | 0-10 | 70-100 | 70-100 | 70-95 | 60-80 | 25-40 | 10-25 |
| | 38-60 | Loam, sandy loam | CL, ML, SM, SC | A-4, A-6, A-2 | 0-10 | 70-95 | 70-95 | 70-90 | 30-75 | 15-30 | 2-12 |
| WzB*, WzC2*, WzD*, WzE*: Waymor---------- | 0-15 | Silt loam------- | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 90-100 | 70-90 | 20-30 | 3-10 |
| | 15-28 | Loam, clay loam, silty clay loam. | CL | A-6, A-7 | 0 | 90-100 | 90-100 | 85-100 | 60-95 | 35-50 | 15-30 |
| | 28-38 | Loam, clay loam | CL | A-6 | 0-10 | 70-100 | 70-100 | 70-95 | 60-80 | 25-40 | 10-25 |
| | 38-60 | Loam, sandy loam | CL, ML, SM, SC | A-4, A-6, A-2 | 0-10 | 70-95 | 70-95 | 70-90 | 30-75 | 15-30 | 2-12 |
| Casco---------- | 0-7 | Sandy loam------ | SM, SM-SC, ML, CL-ML | A-4, A-2 | 0 | 95-100 | 90-100 | 40-75 | 25-55 | <20 | 2-7 |
| | 7-18 | Clay loam, loam, sandy clay loam. | SC, CL | A-6, A-7 | 0-5 | 60-100 | 55-100 | 55-90 | 35-70 | 25-45 | 11-25 |
| | 18-60 | Sand and gravel | GP, SP, GP-GM, SP-SM | A-1, A-3, A-2 | 0-10 | 30-100 | 30-90 | 10-90 | 3-10 | --- | NP |

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification | | Fragments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| WzB*, WzC2*, WzD*, WzE*: | | | | | | | | | | | |
| Zurich | 0-7 | Silt loam | CL-ML, CL | A-4, A-6 | 0 | 100 | 95-100 | 90-100 | 80-95 | 25-40 | 5-20 |
| | 7-27 | Silty clay loam, silt loam. | CL | A-6, A-7 | 0 | 100 | 95-100 | 90-100 | 60-90 | 30-45 | 10-25 |
| | 27-60 | Stratified silt to very fine sand. | ML, CL, SM, SC | A-2, A-4, A-6 | 0 | 90-100 | 80-100 | 70-100 | 30-95 | 20-40 | NP-20 |
| ZuA, ZuB, ZuC2----- Zurich | 0-7 | Silt loam | CL-ML, CL | A-4, A-6 | 0 | 100 | 95-100 | 90-100 | 80-95 | 25-40 | 5-20 |
| | 7-27 | Silty clay loam, silt loam. | CL | A-6, A-7 | 0 | 100 | 95-100 | 90-100 | 60-90 | 30-45 | 10-25 |
| | 27-60 | Stratified silt to very fine sand. | ML, CL, SM, SC | A-2, A-4, A-6 | 0 | 90-100 | 80-100 | 70-100 | 30-95 | 20-40 | NP-20 |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--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 <2mm | Moist bulk density | Permeability | Available water capacity | Reaction | Shrink-swell potential | Erosion factors | | Wind erodibility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | K | T | | |
| | In | Pct | G/cm$^3$ | In/hr | In/in | pH | | | | | Pct |
| AdA---------- | 0-9 | 0-12 | 1.25-1.41 | 2.0-20 | 0.09-0.12 | 5.1-7.3 | Low---------- | 0.17 | 4 | 2 | 1-3 |
| Allendale | 9-26 | 0-15 | 1.35-1.45 | 6.0-20 | 0.06-0.10 | 5.1-7.8 | Low---------- | 0.17 | | | |
| | 26-60 | 40-60 | 1.46-1.75 | 0.06-0.2 | 0.08-0.12 | 6.1-8.4 | High--------- | 0.32 | | | |
| Ax---------- | 0-13 | 10-20 | 1.12-1.59 | 0.6-2.0 | 0.18-0.22 | 6.1-7.3 | Low---------- | 0.32 | 5 | 5 | 1-4 |
| Angelica | 13-21 | 18-35 | 1.48-1.80 | 0.6-2.0 | 0.10-0.18 | 6.1-7.8 | Low---------- | 0.32 | | | |
| | 21-60 | 5-20 | 1.46-1.95 | 0.2-0.6 | 0.10-0.20 | 7.4-8.4 | Low---------- | 0.32 | | | |
| Ba---------- | 0-10 | 2-15 | 1.12-1.59 | 2.0-6.0 | 0.20-0.24 | 6.6-8.4 | Low---------- | 0.28 | 5 | 5 | 1-4 |
| Bach | 10-60 | 0-18 | 1.48-1.95 | 0.6-2.0 | 0.14-0.22 | 7.4-8.4 | Low---------- | 0.28 | | | |
| Bn---------- | 0-7 | 5-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 6.6-7.8 | Low---------- | 0.32 | 4 | 5 | 2-3 |
| Bonduel | 7-20 | 5-20 | 1.45-1.55 | 0.6-2.0 | 0.17-0.22 | 6.6-7.8 | Low---------- | 0.32 | | | |
| | 20-30 | 2-25 | 1.65-1.80 | 0.6-2.0 | 0.14-0.19 | 6.6-8.4 | Low---------- | 0.32 | | | |
| | 30-60 | --- | --- | --- | --- | --- | ---------- | ---- | | | |
| Bo*. | | | | | | | | | | | |
| Borosaprists | | | | | | | | | | | |
| BrB, BrC, BrE---- | 0-26 | 0-10 | 1.14-1.60 | 6.0-20 | 0.10-0.12 | 5.6-7.3 | Low---------- | 0.17 | 4 | 2 | .5-3 |
| Boyer | 26-36 | 10-18 | 1.26-1.59 | 2.0-6.0 | 0.12-0.18 | 5.6-7.8 | Low---------- | 0.24 | | | |
| | 36-60 | 0-10 | 1.20-1.47 | >20 | 0.02-0.04 | 7.4-8.4 | Low---------- | 0.10 | | | |
| Ca---------- | 0-27 | --- | 0.15-0.40 | 0.2-6.0 | 0.35-0.45 | 5.6-7.8 | ---------- | ---- | --- | 3 | 40-65 |
| Carbondale | 27-60 | --- | 0.10-0.17 | 0.6-6.0 | 0.45-0.55 | 5.6-7.8 | ---------- | ---- | | | |
| CbA, CbB, CbC2--- | 0-7 | 5-15 | 1.40-1.70 | 0.6-2.0 | 0.10-0.15 | 5.6-7.3 | Low---------- | 0.32 | 3 | 3 | 1-2 |
| Casco | 7-18 | 18-30 | 1.55-1.65 | 0.6-2.0 | 0.12-0.19 | 5.6-7.8 | Moderate----- | 0.32 | | | |
| | 18-60 | 0-2 | 1.30-2.20 | >20 | 0.02-0.04 | 7.4-8.4 | Low---------- | 0.10 | | | |
| CdB*, CdC2*, CdD2*: | | | | | | | | | | | |
| Casco---------- | 0-7 | 5-15 | 1.40-1.70 | 0.6-2.0 | 0.10-0.15 | 5.6-7.3 | Low---------- | 0.32 | 3 | 3 | 1-2 |
| | 7-18 | 18-30 | 1.55-1.65 | 0.6-2.0 | 0.12-0.19 | 5.6-7.8 | Moderate----- | 0.32 | | | |
| | 18-60 | 0-2 | 1.30-2.20 | >20 | 0.02-0.04 | 7.4-8.4 | Low---------- | 0.10 | | | |
| Rodman--------- | 0-9 | 5-20 | 1.1-1.4 | 2.0-6.0 | 0.09-0.12 | 6.6-7.8 | Low---------- | 0.15 | 3 | 8 | .5-1 |
| | 9-60 | 0-10 | <1.8 | >20 | 0.02-0.04 | 7.4-8.4 | Low---------- | 0.10 | | | |
| Cm---------- | 0-25 | --- | 0.28-0.45 | 0.2-6.0 | 0.45-0.55 | 5.6-7.8 | ---------- | ---- | --- | 3 | 60-85 |
| Cathro | 25-60 | 0-25 | 1.80-1.97 | 0.2-2.0 | 0.11-0.22 | 6.6-8.4 | Low---------- | ---- | | | |
| DrA, DrB--------- | 0-20 | --- | --- | 0.6-2.0 | 0.20-0.24 | 5.6-7.3 | Low---------- | 0.28 | 4 | 6 | 2-4 |
| Dresden | 20-28 | --- | --- | 0.6-2.0 | 0.15-0.20 | 5.6-7.3 | Moderate----- | 0.28 | | | |
| | 28-37 | --- | --- | 0.6-2.0 | 0.15-0.20 | 5.6-7.3 | Moderate----- | 0.28 | | | |
| | 37-60 | --- | --- | >20 | 0.02-0.04 | 7.4-8.4 | Low---------- | 0.10 | | | |
| FaA---------- | 0-7 | 10-18 | 1.25-1.41 | 2.0-6.0 | 0.16-0.22 | 5.6-7.3 | Low---------- | 0.28 | 3 | 5 | 1-4 |
| Fabius | 7-19 | 18-30 | 1.35-1.45 | 2.0-6.0 | 0.15-0.18 | 5.6-7.8 | Low---------- | 0.20 | | | |
| | 19-60 | 0-10 | 1.25-1.50 | >20 | 0.02-0.04 | 7.9-8.4 | Low---------- | 0.10 | | | |
| Fu*. | | | | | | | | | | | |
| Fluvaquents | | | | | | | | | | | |
| HrB, HrC2, HrD2-- | 0-11 | 10-18 | 1.20-1.65 | 0.6-2.0 | 0.20-0.24 | 5.1-7.3 | Low---------- | 0.37 | 5 | 5 | 2-3 |
| Hortonville | 11-37 | 23-35 | 1.55-1.65 | 0.6-2.0 | 0.11-0.20 | 5.1-7.8 | Moderate----- | 0.37 | | | |
| | 37-60 | 20-32 | 1.60-1.70 | 0.6-2.0 | 0.10-0.20 | 7.4-8.4 | Moderate----- | 0.37 | | | |
| HsB*: | | | | | | | | | | | |
| Hortonville----- | 0-11 | 10-18 | 1.20-1.65 | 0.6-2.0 | 0.20-0.24 | 5.1-7.3 | Low---------- | 0.37 | 5 | 5 | 2-3 |
| | 11-37 | 23-35 | 1.55-1.65 | 0.6-2.0 | 0.11-0.20 | 5.1-7.8 | Moderate----- | 0.37 | | | |
| | 37-60 | 20-32 | 1.60-1.70 | 0.6-2.0 | 0.10-0.20 | 7.4-8.4 | Moderate----- | 0.37 | | | |

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth | Clay <2mm | Moist bulk density | Permeability | Available water capacity | Reaction | Shrink-swell potential | Erosion factors K | Erosion factors T | Wind erodibility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | G/cm³ | In/hr | In/in | pH | | | | | Pct |
| HsB*: | | | | | | | | | | | |
| Symco | 0-9 | 10-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 6.6-7.8 | Low | 0.32 | 5 | 5 | 3-7 |
| | 9-28 | 20-40 | 1.55-1.65 | 0.2-0.6 | 0.14-0.22 | 7.4-8.4 | Moderate | 0.43 | | | |
| | 28-60 | 15-35 | 1.65-1.80 | 0.2-0.6 | 0.13-0.20 | 7.4-8.4 | Low | 0.43 | | | |
| HzB*, HzC2*, HzD2*, HzE*: | | | | | | | | | | | |
| Hortonville | 0-11 | 10-18 | 1.20-1.65 | 0.6-2.0 | 0.20-0.24 | 5.1-7.3 | Low | 0.37 | 5 | 5 | 2-3 |
| | 11-37 | 23-35 | 1.55-1.65 | 0.6-2.0 | 0.11-0.20 | 5.1-7.8 | Moderate | 0.37 | | | |
| | 37-60 | 20-32 | 1.60-1.70 | 0.6-2.0 | 0.10-0.20 | 7.4-8.4 | Moderate | 0.37 | | | |
| Boyer | 0-26 | 0-10 | 1.14-1.60 | 6.0-20 | 0.10-0.12 | 5.6-7.3 | Low | 0.17 | 4 | 2 | .5-3 |
| | 26-36 | 10-18 | 1.26-1.59 | 2.0-6.0 | 0.12-0.18 | 5.6-7.8 | Low | 0.24 | | | |
| | 36-60 | 0-10 | 1.20-1.47 | >20 | 0.02-0.04 | 7.4-8.4 | Low | 0.10 | | | |
| Zurich | 0-7 | --- | --- | 0.6-2.0 | 0.22-0.24 | 6.1-7.3 | Low | 0.37 | 5 | 6 | 1-3 |
| | 7-27 | --- | --- | 0.6-2.0 | 0.18-0.22 | 4.5-7.8 | Moderate | 0.37 | | | |
| | 27-60 | --- | --- | 0.6-6.0 | 0.14-0.22 | 7.4-8.4 | Low | 0.37 | | | |
| KhB | 0-8 | 12-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 5.6-7.3 | Low | 0.32 | 3 | 5 | 2-3 |
| Kewaunee | 8-28 | 35-60 | 1.60-1.75 | 0.06-0.6 | 0.07-0.20 | 5.6-7.8 | High | 0.32 | | | |
| | 28-60 | 35-60 | 1.55-1.65 | 0.06-0.6 | 0.06-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| KpB2, KpC2, KpD2- | 0-7 | 30-50 | 1.35-1.60 | 0.2-0.6 | 0.11-0.23 | 5.6-7.3 | Moderate | 0.32 | 2 | 4 | 2-3 |
| Kewaunee | 7-27 | 35-60 | 1.60-1.75 | 0.06-0.6 | 0.07-0.20 | 5.6-7.8 | High | 0.32 | | | |
| | 27-60 | 35-60 | 1.55-1.65 | 0.06-0.6 | 0.06-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| KsC3, KsD3, KsE3- | 0-5 | 30-50 | 1.35-1.60 | 0.2-0.6 | 0.11-0.23 | 5.6-7.3 | Moderate | 0.32 | 2 | 4 | 1-2 |
| Kewaunee | 5-21 | 35-60 | 1.60-1.75 | 0.06-0.6 | 0.07-0.20 | 5.6-7.8 | High | 0.32 | | | |
| | 21-60 | 35-60 | 1.55-1.65 | 0.06-0.6 | 0.06-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| KtB*: | | | | | | | | | | | |
| Kewaunee | 0-8 | 12-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 5.6-7.3 | Low | 0.32 | 3 | 5 | 2-3 |
| | 8-28 | 35-60 | 1.60-1.75 | 0.06-0.6 | 0.07-0.20 | 5.6-7.8 | High | 0.32 | | | |
| | 28-60 | 35-60 | 1.55-1.65 | 0.06-0.6 | 0.06-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| Manawa | 0-9 | 15-27 | 1.30-1.45 | 0.6-2.0 | 0.20-0.24 | 6.1-7.8 | Low | 0.32 | 3 | 5 | 2-4 |
| | 9-32 | 35-60 | 1.55-1.65 | 0.06-0.2 | 0.09-0.20 | 6.1-8.4 | Moderate | 0.32 | | | |
| | 32-60 | 35-60 | 1.85-1.95 | 0.06-0.2 | 0.08-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| KuA | 0-12 | 5-25 | 1.43-1.73 | 0.6-2.0 | 0.16-0.24 | 5.6-7.3 | Low | 0.28 | 5 | 5 | 1-3 |
| Kibbie | 12-27 | 5-35 | 1.44-1.81 | 0.6-2.0 | 0.17-0.22 | 5.6-7.3 | Low | 0.43 | | | |
| | 27-60 | 2-18 | 1.47-1.90 | 0.6-2.0 | 0.12-0.22 | 7.4-8.4 | Low | 0.43 | | | |
| KvA | 0-9 | 5-20 | 1.35-1.55 | 0.6-2.0 | 0.22-0.24 | 7.4-7.8 | Low | 0.32 | 5 | 5 | 2-4 |
| Kibbie Variant | 9-25 | 30-50 | 1.35-1.65 | 0.06-0.6 | 0.11-0.20 | 7.4-7.8 | Moderate | 0.32 | | | |
| | 25-60 | 5-20 | 1.65-1.85 | 0.6-2.0 | 0.17-0.22 | 7.4-8.4 | Low | 0.43 | | | |
| KwB, KwC2 | 0-6 | 15-20 | 1.35-1.65 | 0.6-2.0 | 0.20-0.24 | 5.6-7.3 | Low | 0.37 | 4 | 5 | 1-2 |
| Kolberg | 6-31 | 30-60 | 1.35-1.65 | 0.06-0.6 | 0.09-0.20 | 6.6-7.8 | Moderate | 0.28 | | | |
| | 31-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| KxB | 0-8 | 15-20 | 1.35-1.60 | 0.6-2.0 | 0.20-0.22 | 6.6-7.8 | Low | 0.37 | 2 | 5 | 1-2 |
| Kolberg Variant | 8-18 | 30-60 | 1.35-1.60 | 0.2-0.6 | 0.11-0.20 | 6.6-7.8 | Moderate | 0.28 | | | |
| | 18-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| LmA | 0-13 | 15-25 | 1.35-1.55 | 0.6-2.0 | 0.22-0.24 | 5.6-7.8 | Low | 0.32 | 5 | 5 | 2-3 |
| Lamartine | 13-21 | 25-32 | 1.55-1.65 | 0.6-2.0 | 0.18-0.22 | 5.6-7.8 | Moderate | 0.32 | | | |
| | 21-33 | 20-30 | 1.55-1.65 | 0.6-2.0 | 0.13-0.19 | 6.6-7.8 | Moderate | 0.32 | | | |
| | 33-60 | 5-20 | 1.50-1.85 | 0.6-6.0 | 0.11-0.19 | 7.4-8.4 | Low | 0.32 | | | |
| LoB | 0-7 | 5-15 | 1.10-1.64 | 2.0-6.0 | 0.10-0.20 | 5.6-7.3 | Low | 0.32 | 4 | 3 | 1-3 |
| Longrie | 7-24 | 10-18 | 1.22-1.87 | 0.6-6.0 | 0.09-0.19 | 5.6-7.8 | Low | 0.32 | | | |
| | 24-28 | 10-18 | 1.31-1.99 | 0.6-6.0 | 0.08-0.18 | 6.6-8.4 | Low | 0.32 | | | |
| | 28-60 | --- | --- | --- | --- | --- | --- | --- | | | |

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth | Clay <2mm | 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 |
| McA | 0-9 | 15-27 | 1.30-1.45 | 0.6-2.0 | 0.20-0.24 | 6.1-7.8 | Low | 0.32 | 3 | 5 | 2-4 |
| Manawa | 9-32 | 35-60 | 1.55-1.65 | 0.06-0.2 | 0.09-0.20 | 6.1-8.4 | Moderate | 0.32 | | | |
| | 32-60 | 35-60 | 1.85-1.95 | 0.06-0.2 | 0.08-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| MeB | 0-9 | --- | --- | 6.0-20 | 0.10-0.12 | 5.1-6.5 | Low | 0.17 | 4 | 2 | .5-1 |
| Manistee | 9-30 | --- | --- | 6.0-20 | 0.06-0.10 | 5.1-7.3 | Low | 0.17 | | | |
| | 30-60 | --- | --- | 0.06-0.2 | 0.08-0.12 | 5.6-8.4 | High | 0.32 | | | |
| Mk | 0-26 | --- | 0.15-0.45 | 0.2-6.0 | 0.35-0.45 | 5.6-7.8 | --- | --- | --- | 3 | 55-85 |
| Markey | 26-60 | --- | 1.58-1.64 | 6.0-20 | 0.03-0.08 | 6.1-8.4 | Low | --- | | | |
| MmA | 0-10 | 10-20 | 1.29-1.72 | 2.0-6.0 | 0.13-0.24 | 5.6-7.3 | Low | 0.28 | 4 | 5 | 2-3 |
| Matherton | 10-27 | 20-35 | 1.40-1.83 | 0.6-2.0 | 0.16-0.18 | 5.6-7.3 | Low | 0.28 | | | |
| | 27-60 | 0-10 | 1.50-1.65 | >20 | 0.02-0.04 | 7.4-8.4 | Low | 0.10 | | | |
| MrB | 0-7 | --- | --- | 6.0-20 | 0.10-0.12 | 5.1-6.5 | Low | 0.17 | 5 | 2 | 2-3 |
| Menominee | 7-28 | --- | --- | 6.0-20 | 0.06-0.08 | 5.1-6.5 | Low | 0.17 | | | |
| | 28-42 | --- | --- | 0.6-2.0 | 0.15-0.20 | 5.6-8.4 | Moderate | 0.32 | | | |
| | 42-60 | --- | --- | 0.6-2.0 | 0.11-0.19 | 5.6-8.4 | Low | 0.32 | | | |
| MsB | 0-9 | 2-15 | 1.10-1.65 | 2.0-6.0 | 0.10-0.12 | 6.6-7.3 | Low | 0.17 | 5 | 2 | 2-3 |
| Menominee | 9-32 | 1-10 | 1.40-1.65 | 6.0-20. | 0.06-0.08 | 6.6-7.3 | Low | 0.17 | | | |
| Variant | 32-38 | 15-25 | 1.35-1.55 | 0.6-2.0 | 0.15-0.19 | 6.6-7.3 | Low | 0.28 | | | |
| | 38-60 | 1-10 | 1.80-1.90 | >20 | 0.02-0.04 | 6.6-7.8 | Low | 0.10 | | | |
| MtA | 0-9 | 10-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 5.6-7.8 | Low | 0.28 | 5 | 5 | 3-4 |
| Mosel | 9-20 | 10-35 | 1.55-1.65 | 0.6-6.0 | 0.13-0.19 | 5.6-7.8 | Low | 0.28 | | | |
| | 20-60 | 27-60 | 1.55-1.65 | 0.06-0.6 | 0.07-0.20 | 7.4-8.4 | Moderate | 0.43 | | | |
| My | 0-11 | 10-18 | 1.35-1.50 | 0.6-6.0 | 0.12-0.20 | 6.1-7.8 | Low | 0.24 | 3 | 3 | 4-6 |
| Mussey | 11-17 | 18-30 | 1.40-1.55 | 0.6-2.0 | 0.08-0.19 | 6.1-7.8 | Low | 0.24 | | | |
| | 17-19 | 18-30 | 1.40-1.55 | 0.6-2.0 | 0.08-0.16 | 6.1-7.8 | Moderate | 0.24 | | | |
| | 19-60 | 0-10 | 1.40-1.65 | 6.0-20 | 0.02-0.03 | 7.4-7.8 | Low | 0.10 | | | |
| NaB | 0-7 | 12-20 | 1.35-1.65 | 0.6-2.0 | 0.20-0.24 | 6.1-7.8 | Low | 0.32 | 1 | 5 | 2-4 |
| Namur | 7-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| NrD*: | | | | | | | | | | | |
| Namur | 0-7 | 12-20 | 1.35-1.65 | 0.6-2.0 | 0.20-0.24 | 6.1-7.8 | Low | 0.32 | 1 | 5 | 2-4 |
| | 7-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| Rock outcrop. | | | | | | | | | | | |
| NxB | 0-7 | 2-15 | 1.20-1.70 | 0.6-2.0 | 0.16-0.22 | 6.1-7.8 | Low | 0.24 | 5 | 3 | 1-2 |
| Nichols | 7-27 | 8-18 | 1.45-1.65 | 0.6-2.0 | 0.17-0.22 | 6.6-8.4 | Low | 0.37 | | | |
| | 27-60 | 3-15 | 1.65-1.80 | 0.6-2.0 | 0.08-0.13 | 7.9-8.4 | Low | 0.37 | | | |
| OaB, OaC | 0-7 | 2-14 | 1.27-1.56 | 6.0-20 | 0.09-0.11 | 5.6-7.3 | Low | 0.15 | 5 | 2 | .5-2 |
| Oakville | 7-60 | 0-10 | 1.26-1.67 | 6.0-20 | 0.06-0.08 | 5.6-7.3 | Low | 0.15 | | | |
| OdB | 0-6 | 14-27 | 1.35-1.60 | 0.6-2.0 | 0.20-0.24 | 5.6-7.8 | Low | 0.37 | 3 | 5 | 2-3 |
| Omro | 6-27 | 35-60 | 1.35-1.50 | 0.06-0.6 | 0.09-0.13 | 5.6-7.8 | Moderate | 0.28 | | | |
| | 27-60 | 5-15 | 1.35-1.85 | 0.6-2.0 | 0.08-0.19 | 7.4-8.4 | Low | 0.28 | | | |
| OeC2 | 0-5 | 27-40 | 1.35-1.60 | 0.2-0.6 | 0.21-0.23 | 5.6-7.8 | Moderate | 0.28 | 3 | 6 | 2-3 |
| Omro | 5-25 | 35-60 | 1.35-1.50 | 0.06-0.6 | 0.09-0.13 | 5.6-7.8 | Moderate | 0.28 | | | |
| | 25-60 | 5-15 | 1.35-1.85 | 0.6-2.0 | 0.08-0.19 | 7.4-8.4 | Low | 0.28 | | | |
| OhB, OhC2 | 0-15 | 10-22 | 1.31-1.78 | 0.6-2.0 | 0.14-0.20 | 5.6-7.8 | Low | 0.32 | 5 | 5 | 1-3 |
| Onaway | 15-28 | 18-35 | 1.31-1.86 | 0.6-2.0 | 0.12-0.18 | 5.6-7.8 | Moderate | 0.32 | | | |
| | 28-60 | 5-25 | 1.33-1.89 | 0.6-2.0 | 0.10-0.20 | 7.4-8.4 | Low | 0.32 | | | |
| Pe | 0-14 | --- | --- | 0.6-2.0 | 0.22-0.24 | 6.1-7.8 | Moderate | 0.28 | 5 | 6 | 5-6 |
| Pella | 14-27 | --- | --- | 0.6-2.0 | 0.21-0.24 | 7.4-8.4 | Moderate | 0.28 | | | |
| | 27-60 | --- | --- | 0.6-2.0 | 0.10-0.22 | 7.4-8.4 | Low | 0.28 | | | |

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth | Clay <2mm | 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 |
| Pg*. Pits | | | | | | | | | | | |
| Po | 0-9 | 27-45 | 1.35-1.65 | 0.2-0.6 | 0.11-0.23 | 6.1-7.8 | Moderate | 0.32 | 3 | 7 | 4-7 |
| Poygan | 9-27 | 35-60 | 1.65-1.75 | 0.06-0.2 | 0.09-0.18 | 6.1-7.8 | Moderate | 0.32 | | | |
| | 27-60 | 35-60 | 1.85-1.95 | 0.06-0.2 | 0.08-0.20 | 7.4-8.4 | Moderate | 0.32 | | | |
| RcE*: | | | | | | | | | | | |
| Rodman | 0-9 | 5-20 | 1.1-1.4 | 2.0-6.0 | 0.09-0.12 | 6.6-7.8 | Low | 0.15 | 3 | 8 | .5-1 |
| | 9-60 | 0-10 | <1.8 | >20 | 0.02-0.04 | 7.4-8.4 | Low | 0.10 | | | |
| Casco | 0-4 | 5-15 | 1.40-1.70 | 0.6-2.0 | 0.10-0.15 | 5.6-7.3 | Low | 0.32 | 3 | 3 | 1-2 |
| | 4-12 | 18-30 | 1.55-1.65 | 0.6-2.0 | 0.12-0.19 | 5.6-7.8 | Moderate | 0.32 | | | |
| | 12-60 | 0-2 | 1.30-2.20 | >20 | 0.02-0.04 | 7.4-8.4 | Low | 0.10 | | | |
| Rs | 0-9 | 0-12 | 0.92-1.59 | 6.0-20 | 0.07-0.20 | 6.1-7.8 | Low | 0.17 | 5 | 2 | 6-8 |
| Roscommon | 9-60 | 0-10 | 1.45-1.74 | 6.0-20 | 0.05-0.07 | 6.1-7.8 | Low | 0.17 | | | |
| Ru | 0-9 | 10-20 | 1.12-1.59 | 0.6-2.0 | 0.12-0.22 | 6.1-7.8 | Low | 0.24 | 2 | 5 | 4-6 |
| Ruse | 9-14 | 10-25 | 1.48-1.80 | 0.6-2.0 | 0.10-0.20 | 6.1-7.8 | Low | 0.24 | | | |
| | 14-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| ShA | 0-9 | 5-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 6.1-7.8 | Low | 0.32 | 5 | 5 | 2-4 |
| Shiocton | 9-25 | 3-18 | 1.45-1.65 | 0.6-2.0 | 0.17-0.22 | 6.6-8.4 | Low | 0.43 | | | |
| | 25-60 | 3-18 | 1.65-1.80 | 0.6-2.0 | 0.08-0.13 | 7.4-8.4 | Low | 0.43 | | | |
| SoA | 0-9 | 15-20 | 1.35-1.55 | 0.6-2.0 | 0.19-0.24 | 6.6-7.8 | Low | 0.32 | 5 | 5 | 1-3 |
| Solona | 9-28 | 15-30 | 1.45-1.65 | 0.6-2.0 | 0.11-0.19 | 6.6-7.8 | Low | 0.32 | | | |
| | 28-60 | 5-20 | 1.65-1.80 | 0.6-2.0 | 0.09-0.19 | 7.4-8.4 | Low | 0.32 | | | |
| SyA | 0-9 | 10-20 | 1.35-1.55 | 0.6-2.0 | 0.20-0.24 | 6.6-7.8 | Low | 0.32 | 5 | 5 | 3-7 |
| Symco | 9-28 | 20-40 | 1.55-1.65 | 0.2-0.6 | 0.14-0.22 | 7.4-8.4 | Moderate | 0.43 | | | |
| | 28-60 | 15-35 | 1.65-1.80 | 0.2-0.6 | 0.13-0.20 | 7.4-8.4 | Low | 0.43 | | | |
| Uf*. Udifluvents | | | | | | | | | | | |
| UoB*, UoF*. Udorthents | | | | | | | | | | | |
| WaA | 0-9 | 0-10 | 1.35-1.50 | 6.0-20 | 0.10-0.12 | 5.1-6.5 | Low | 0.15 | 5 | 2 | 2-4 |
| Wainola | 9-29 | 2-12 | 1.35-1.45 | 6.0-20 | 0.06-0.11 | 5.1-6.5 | Low | 0.15 | | | |
| | 29-60 | 0-10 | 1.25-1.50 | 6.0-20 | 0.05-0.07 | 5.6-7.4 | Low | 0.15 | | | |
| We | 0-12 | 7-18 | --- | 2.0-6.0 | 0.13-0.18 | 6.1-7.3 | Low | 0.20 | 4 | 3 | 4-8 |
| Wauseon | 12-25 | 5-18 | --- | 6.0-20 | 0.06-0.16 | 6.6-7.8 | Low | 0.20 | | | |
| | 25-60 | 27-55 | --- | <0.06 | 0.08-0.18 | 7.4-8.4 | High | 0.32 | | | |
| WoB, WoC2, WoD2 | 0-15 | 12-20 | 1.35-1.55 | 0.6-2.0 | 0.22-0.24 | 6.1-7.8 | Low | 0.37 | 5 | 5 | 2-3 |
| Waymor | 15-28 | 15-35 | 1.55-1.65 | 0.6-2.0 | 0.15-0.20 | 6.1-7.8 | Moderate | 0.37 | | | |
| | 28-38 | 15-30 | 1.55-1.65 | 0.6-2.0 | 0.15-0.19 | 6.1-7.8 | Moderate | 0.37 | | | |
| | 38-60 | 5-20 | 1.80-1.90 | 0.6-2.0 | 0.14-0.19 | 7.4-8.4 | Low | 0.28 | | | |
| WzB*, WzC2*, WzD*, WzE*: | | | | | | | | | | | |
| Waymor | 0-15 | 12-20 | 1.35-1.55 | 0.6-2.0 | 0.22-0.24 | 6.1-7.8 | Low | 0.37 | 5 | 5 | 2-3 |
| | 15-28 | 15-35 | 1.55-1.65 | 0.6-2.0 | 0.15-0.20 | 6.1-7.8 | Moderate | 0.37 | | | |
| | 28-38 | 15-30 | 1.55-1.65 | 0.6-2.0 | 0.15-0.19 | 6.1-7.8 | Moderate | 0.37 | | | |
| | 38-60 | 5-20 | 1.80-1.90 | 0.6-2.0 | 0.14-0.19 | 7.4-8.4 | Low | 0.28 | | | |
| Casco | 0-7 | 5-15 | 1.40-1.70 | 0.6-2.0 | 0.10-0.15 | 5.6-7.3 | Low | 0.32 | 3 | 3 | 1-2 |
| | 7-18 | 18-30 | 1.55-1.65 | 0.6-2.0 | 0.12-0.19 | 5.6-7.8 | Moderate | 0.32 | | | |
| | 18-60 | 0-2 | 1.30-2.20 | >20 | 0.02-0.04 | 7.4-8.4 | Low | 0.10 | | | |
| Zurich | 0-7 | --- | --- | 0.6-2.0 | 0.22-0.24 | 6.1-7.3 | Low | 0.37 | 5 | 6 | 1-3 |
| | 7-27 | --- | --- | 0.6-2.0 | 0.18-0.22 | 4.5-7.8 | Moderate | 0.37 | | | |
| | 27-60 | --- | --- | 0.6-6.0 | 0.14-0.22 | 7.4-8.4 | Low | 0.37 | | | |

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth | Clay <2mm | Moist bulk density | Permeability | Available water capacity | Reaction | Shrink-swell potential | Erosion factors | | Wind erodibility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | K | T | | |
| | In | Pct | G/cm$^3$ | In/hr | In/in | pH | | | | | Pct |
| ZuA, ZuB, ZuC2---Zurich | 0-7 | --- | --- | 0.6-2.0 | 0.22-0.24 | 6.1-7.3 | Low---------- | 0.37 | 5 | 6 | 1-3 |
| | 7-27 | --- | --- | 0.6-2.0 | 0.18-0.22 | 4.5-7.8 | Moderate----- | 0.37 | | | |
| | 27-60 | --- | --- | 0.6-6.0 | 0.14-0.22 | 7.4-8.4 | Low---------- | 0.37 | | | |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

| Soil name and map symbol | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Subsidence | Potential frost action | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | | | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | In | | | |
| AdA---------- Allendale | B | None-------- | --- | --- | 0.5-1.5 | Apparent | Nov-May | >60 | --- | --- | Moderate | High----- | Moderate. |
| Ax---------- Angelica | B/D | Frequent---- | Long------ | Nov-May | 0-1.0 | Apparent | Oct-Jun | >60 | --- | --- | High----- | High----- | Low. |
| Ba---------- Bach | B/D | Frequent---- | Long------ | Oct-May | 0-1.0 | Apparent | Sep-Jun | >60 | --- | --- | High----- | High----- | Low. |
| Bn---------- Bonduel | C | Rare-------- | --- | --- | 1.0-3.0 | Apparent | Sep-Jun | 20-40 | Hard | --- | High----- | Moderate | Low. |
| Bo*. Borosaprists | | | | | | | | | | | | | |
| BrB, BrC, BrE--- Boyer | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low------ | Low------ | Moderate. |
| Ca---------- Carbondale | A/D | Frequent---- | Long------ | Nov-May | 0-1.0 | Apparent | Sep-May | >60 | --- | --- | High----- | High----- | Moderate. |
| CbA, CbB, CbC2-- Casco | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Low------ | Low. |
| CdB*, CdC2*, CdD2*: | | | | | | | | | | | | | |
| Casco---------- | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Low------ | Low. |
| Rodman--------- | A | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low------ | Low------ | Low. |
| Cm---------- Cathro | A/D | Frequent---- | Long------ | Nov-May | 0-1.0 | Apparent | Nov-Jun | >60 | --- | 19-22 | High----- | High----- | Low. |
| DrA, DrB--------- Dresden | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Low. |
| FaA---------- Fabius | B | Rare-------- | --- | --- | 1.0-2.0 | Apparent | Nov-May | >60 | --- | --- | High----- | Moderate | Moderate. |
| Fu*. Fluvaquents | | | | | | | | | | | | | |
| HrB, HrC2, HrD2- Hortonville | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Moderate. |
| HsB*: | | | | | | | | | | | | | |
| Hortonville---- | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Moderate. |
| Symco---------- | B | Occasional | Brief----- | Mar-May | 1.0-3.0 | Apparent | Nov-May | >60 | --- | --- | High----- | High----- | Low. |

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

| Soil name and map symbol | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Subsidence | Potential frost action | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | | | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | In | | | |
| HzB*, HzC2*, HzD2*, HzE*: | | | | | | | | | | | | | |
| Hortonville | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Moderate. |
| Boyer | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low | Low | Moderate. |
| Zurich | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | High | Moderate | Moderate. |
| KhB, KpB2, KpC2, KpD2, KsC3, KsD3, KsE3---- Kewaunee | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | High | Low. |
| KtB*: | | | | | | | | | | | | | |
| Kewaunee | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | High | Low. |
| Manawa | C | Occasional | Brief | Nov-May | 1.0-3.0 | Perched | Nov-Jun | >60 | --- | --- | High | High | Low. |
| KuA---------- Kibbie | B | None | --- | --- | 1.0-2.0 | Apparent | Nov-May | >60 | --- | --- | High | Low | High. |
| KvA---------- Kibbie Variant | C | Occasional | Brief | Nov-May | 1.0-3.0 | Apparent | Mar-Jul | >60 | --- | --- | High | Moderate | Low. |
| KwB, KwC2---- Kolberg | C | None | --- | --- | >6.0 | --- | --- | 20-40 | Hard | --- | Moderate | Moderate | Low. |
| KxB---------- Kolberg Variant | D | None | --- | --- | >6.0 | --- | --- | 12-24 | Hard | --- | Moderate | Moderate | Low. |
| LmA---------- Lamartine | C | Occasional | Very brief | Nov-May | 1.0-3.0 | Apparent | Nov-May | >60 | --- | --- | High | High | Low. |
| LoB---------- Longrie | B | None | --- | --- | >6.0 | --- | --- | 20-40 | Hard | --- | Moderate | Low | Low. |
| McA---------- Manawa | C | Occasional | Brief | Nov-May | 1.0-3.0 | Perched | Nov-Jun | >60 | --- | --- | High | High | Low. |
| MeB---------- Manistee | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low | High | Moderate. |
| Mk---------- Markey | A/D | Frequent | Long | Nov-May | 0-1.0 | Apparent | Nov-Jun | >60 | --- | 25-30 | High | High | Low. |
| MmA---------- Matherton | B | None | --- | --- | 1.0-2.0 | Apparent | Nov-May | >60 | --- | --- | High | High | Moderate. |
| MrB---------- Menominee | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Moderate. |
| MsB---------- Menominee Variant | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low | Low | Low. |

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

| Soil name and map symbol | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Subsidence | Potential frost action | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | | | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | In | | | |
| MtA---------- Mosel | C | Frequent---- | Brief----- | Mar-Apr | 1.0-3.0 | Perched | Nov-May | >60 | --- | --- | High----- | High----- | Low. |
| My---------- Mussey | B/D | Frequent---- | Long------ | Nov-Jun | 0-1.5 | Apparent | Nov-Jun | >60 | --- | --- | High----- | High----- | Low. |
| NaB---------- Namur | D | None-------- | --- | --- | >6.0 | --- | --- | 5-12 | Hard | --- | Moderate | Moderate | Low. |
| NrD*: Namur---------- | D | None-------- | --- | --- | >6.0 | --- | --- | 5-12 | Hard | --- | Moderate | Moderate | Low. |
| Rock outcrop. | | | | | | | | | | | | | |
| NxB---------- Nichols | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | High----- | Low------ | Low. |
| OaB, OaC--------- Oakville | A | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low------ | Low------ | Moderate. |
| OdB, OeC2------- Omro | C | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | High----- | Low. |
| OhB, OhC2------- Onaway | D | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Low------ | Moderate. |
| Pe---------- Pella | B/D | Occasional | Brief----- | Mar-Jun | 0-2.0 | Apparent | Mar-Jun | >60 | --- | --- | High----- | High----- | Moderate. |
| Pg*. Pits | | | | | | | | | | | | | |
| Po---------- Poygan | D | Frequent---- | Long------ | Nov-Jun | 0-1.0 | Perched | Nov-Jul | >60 | --- | --- | High----- | High----- | Low. |
| RcE*: Rodman--------- | A | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Low------ | Low------ | Low. |
| Casco---------- | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Low------ | Low. |
| Rs---------- Roscommon | A/D | Frequent---- | Brief----- | Sep-May | 0-1.0 | Apparent | Sep-Jun | >60 | --- | --- | Moderate | High----- | Low. |
| Ru---------- Ruse | D | Frequent---- | Brief----- | Nov-May | 0-0.5 | Apparent | Nov-May | 10-20 | Hard | --- | High----- | High----- | Low. |
| ShA---------- Shiocton | B | Occasional | Long------ | Mar-May | 1.0-3.0 | Apparent | Sep-Jul | >60 | --- | --- | High----- | Moderate | Low. |
| SoA---------- Solona | B | Occasional | Brief----- | Apr-Jun | 1.0-3.0 | Apparent | Mar-Jul | >60 | --- | --- | High----- | High----- | Low. |
| SyA---------- Symco | B | Occasional | Brief----- | Mar-May | 1.0-3.0 | Apparent | Nov-May | >60 | --- | --- | High----- | High----- | Low. |

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

| Soil name and map symbol | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Subsidence | Potential frost action | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | | | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | In | | | |
| Uf*. Udifluvents | | | | | | | | | | | | | |
| UoB*, UoF*. Udorthents | | | | | | | | | | | | | |
| WaA---------- Wainola | A | None-------- | --- | --- | 1.0-2.0 | Apparent | Nov-May | >60 | --- | --- | Moderate | Low------ | Moderate. |
| We---------- Wauseon | B/D | None-------- | --- | --- | 0-0.5 | Perched | Jan-Apr | >60 | --- | --- | High----- | High----- | Low. |
| WoB, WoC2, WoD2- Waymor | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Low. |
| WzB*, WzC2*, WzD*, WzE*: | | | | | | | | | | | | | |
| Waymor-------- | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Moderate | Low. |
| Casco--------- | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | Moderate | Low------ | Low. |
| Zurich-------- | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | High----- | Moderate | Moderate. |
| ZuA, ZuB, ZuC2-- Zurich | B | None-------- | --- | --- | >6.0 | --- | --- | >60 | --- | --- | High----- | Moderate | Moderate. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

[Tests performed by the Wisconsin Department of Transportation, Division of Highways. Absence of an entry indicates that no determination was made]

| Soil name and location | Parent material | Sample number | Depth | Moisture density | | Grain-size distribution[1] | | | | | | | | Liquid limit | Plasticity index | Classification | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Percentage passing sieve-- | | | | Percentage smaller than-- | | | | | | | |
| | | | | Maximum dry density | Optimum moisture | No. 4 | No. 10 | No. 40 | No. 200 | 0.05 mm | 0.02 mm | 0.005 mm | 0.002 mm | | | AASHTO | Unified |
| | | | In | Lb/cu ft | Pct | | | | | | | | | Pct | | | |
| Boyer loamy sand:[2] | | | | | | | | | | | | | | | | | |
| SW1/4SE1/4 sec. 36, T. 22 N., R. 23 E. | Loamy deposits and glacial outwash sand and gravel | S76WI-61-2 2-1 | 26-35 | --- | --- | 98 | 96 | 84 | 13 | 13 | 11 | 7 | 6 | --- | NP[3] | A-2-4 (0) | SM-SC |
| | | 2-2 | 52-60 | --- | --- | 92 | 78 | 44 | 7 | 6 | 3 | 2 | 1 | --- | NP | A-1-b (0) | SP-SM |
| Casco sandy loam: | | | | | | | | | | | | | | | | | |
| SE1/4SE1/4 sec. 20, T. 23 N., R. 24 E. | Loamy deposits and glacial outwash sand and gravel. | S75WI-61-2 2-1 | 11-14 | --- | --- | 79 | 73 | 58 | 40 | 36 | 28 | 20 | 17 | 35.1 | 15.1 | A-6(2) | SC |
| | | 2-2 | 45-48 | --- | --- | 32 | 24 | 16 | 4 | 2 | 1 | 1 | 0 | --- | NP | A-1-a (0) | GP |
| Hortonville silt loam: | | | | | | | | | | | | | | | | | |
| SW1/4SE1/4 sec. 4, T. 23 N., R. 24 E. | Thin loess and loamy glacial till. | S74WI-W-2 2-1 | 13-24 | --- | --- | -- | 100 | 96 | 71 | 67 | 59 | 45 | 36 | 39.8 | 22.6 | A-6(12) | CL |
| | | 2-2 | 42-48 | 120.2 | 12.3 | 94 | 91 | 85 | 63 | 58 | 48 | 33 | 23 | 27.2 | 13.1 | A-6(7) | CL |
| Kewaunee silt loam:[2] | | | | | | | | | | | | | | | | | |
| NW1/4NW1/4 sec. 10, T. 25 N., R. 23 E. | Thin loess and clayey glacial till. | S74WI-61-3 3-1 | 11-19 | --- | --- | -- | 100 | 97 | 82 | 79 | 73 | 59 | 45 | 51.2 | 31.6 | A-7-6 (18) | CH |
| | | 3-2 | 42-48 | 114.8 | 13.4 | 90 | 88 | 83 | 70 | 67 | 58 | 42 | 29 | 33.3 | 17.4 | A-6(10) | CL |
| Longrie loam:[2] | | | | | | | | | | | | | | | | | |
| NE1/4NW1/4 sec. 5, T. 25 N., R. 25 E. | Loamy glacial till. | S75WI-61-4 4-1 | 12-19 | --- | --- | 96 | 94 | 90 | 59 | 53 | 42 | 29 | 22 | 29.4 | 11.8 | A-6(5) | CL |
| | | 4-2 | 24-28 | --- | --- | 90 | 85 | 78 | 51 | 45 | 31 | 17 | 13 | 17.8 | 5.0 | A-4(3) | CL-ML |
| Matherton silt loam:[2] | | | | | | | | | | | | | | | | | |
| NW1/4NW1/4 sec. 32, T. 23 N., R. 24 E. | Loamy deposits and glacial outwash sand and gravel. | S76WI-61-4 4-1 | 16-21 | --- | --- | 93 | 90 | 73 | 26 | 24 | 21 | 18 | 17 | 25.8 | 9.0 | A-2-4 (0) | CL |
| | | 4-2 | 42-60 | --- | --- | 77 | 68 | 40 | 10 | 7 | 3 | 2 | 1 | --- | NP | A-1-b (0) | SM-SC |
| Onaway loam:[2] | | | | | | | | | | | | | | | | | |
| SW1/4NW1/4 sec. 1, T. 25 N., R. 25 E. | Loamy glacial till. | S76WI-61-3 3-1 | 19-29 | --- | --- | 98 | 97 | 93 | 52 | 46 | 35 | 23 | 18 | 22.8 | 8.1 | A-4(3) | CL |
| | | 3-2 | 36-60 | 123.6 | 10.5 | 92 | 89 | 84 | 56 | 48 | 35 | 22 | 15 | 21.2 | 7.6 | A-4(4) | CL |

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

| Soil name and location | Parent material | Sample number | Depth | Moisture density | | Grain-size distribution[1] | | | | | | | | Liquid limit | Plasticity index | Classification | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Percentage passing sieve-- | | | | Percentage smaller than-- | | | | | | | |
| | | | | Maximum dry density | Optimum moisture | No. 4 | No. 10 | No. 40 | No. 200 | 0.05 mm | 0.02 mm | 0.005 mm | 0.002 mm | | | AASHTO | Unified |
| | | | In | Lb/cu ft | Pct | | | | | | | | | Pct | | | |
| Onaway loam:[2] | | | | | | | | | | | | | | | | | |
| SW1/4NW1/4 sec. 21, T. 25 N., R. 25 E. | Loamy glacial till. | S75WI-61-3 | | | | | | | | | | | | | | | |
| | | 3-1 | 18-25 | --- | --- | 96 | 93 | 85 | 50 | 47 | 38 | 28 | 23 | 28.4 | 13.4 | A-6(4) | CL or SC |
| | | 3-2 | 42-48 | 131.8 | 8.6 | 80 | 75 | 66 | 41 | 36 | 26 | 15 | 9 | 16.2 | 2.9 | A-4(1) | SM |
| Symco silt loam: | | | | | | | | | | | | | | | | | |
| SW1/4NE1/4 sec. 34, T. 23 N., R. 24 E. | Loamy glacial till. | S76WI-61-1 | | | | | | | | | | | | | | | |
| | | 1-1 | 9-15 | --- | --- | 96 | 93 | 89 | 66 | 60 | 49 | 37 | 29 | 33.5 | 17.7 | A-6(9) | CL |
| | | 1-2 | 30-60 | 119.0 | 13.0 | 96 | 92 | 87 | 66 | 60 | 48 | 31 | 21 | 26.2 | 13.0 | A-6(7) | CL |
| Symco silt loam: | | | | | | | | | | | | | | | | | |
| NE1/4NW1/4 sec. 35, T. 23 N., R. 24 E. | Loamy glacial till. | S75WI-61-1 | | | | | | | | | | | | | | | |
| | | 1-1 | 13-21 | --- | --- | 99 | 99 | 95 | 74 | 70 | 63 | 48 | 35 | 39.2 | 21.6 | A-6(12) | CL |
| | | 1-2 | 27-30 | --- | --- | 90 | 86 | 79 | 57 | 52 | 41 | 28 | 20 | 23.2 | 10.2 | A-4(4) | CL |
| Waymor silt loam: | | | | | | | | | | | | | | | | | |
| SW1/4NW1/4 sec. 30, T. 22 N., R. 23 E. | Thin loess and loamy glacial till. | S74WI-61-1 | | | | | | | | | | | | | | | |
| | | 1-1 | 28-35 | --- | --- | -- | 100 | 95 | 64 | 59 | 47 | 33 | 27 | 29.6 | 12.7 | A-6(7) | CL |
| | | 1-2 | 42-48 | 130.9 | 8.4 | 86 | 82 | 71 | 43 | 38 | 25 | 13 | 7 | 15.8 | 1.6 | A-4(2) | SM |

[1] Mechanical analysis according to the AASHTO Designation T88-57 (1). Results from this procedure can differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by hydrometer method and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fraction. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soils.

[2] These soils are taxadjuncts. See the series description for explanation.

[3] NP means nonplastic.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that 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]

| Soil name | Family or higher taxonomic class |
|---|---|
| Allendale | Sandy over clayey, mixed, frigid Aqualfic Haplorthods |
| Angelica | Fine-loamy, mixed, nonacid, frigid Aeric Haplaquepts |
| *Bach | Coarse-silty, mixed (calcareous), mesic Mollic Haplaquepts |
| Bonduel | Fine-loamy, mixed Aquic Eutroboralfs |
| Borosaprists | Euic Borosaprists |
| *Boyer | Coarse-loamy, mixed, mesic Typic Hapludalfs |
| Carbondale | Euic Hemic Borosaprists |
| Casco | Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs |
| Cathro | Loamy, mixed, euic Terric Borosaprists |
| *Dresden | Fine-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs |
| Fabius | Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Argiudolls |
| Fluvaquents | Mixed, nonacid, mesic Fluvaquents |
| Hortonville | Fine-loamy, mixed, mesic Glossoboric Hapludalfs |
| *Kewaunee | Fine, mixed, mesic Typic Hapludalfs |
| Kibbie | Fine-loamy, mixed, mesic Aquollic Hapludalfs |
| Kibbie Variant | Fine, mixed, mesic Aquollic Hapludalfs |
| Kolberg | Fine, mixed Glossic Eutroboralfs |
| Kolberg Variant | Clayey, mixed Lithic Eutroboralfs |
| *Lamartine | Fine-silty, mixed, mesic Aquollic Hapludalfs |
| Longrie | Coarse-loamy, mixed, frigid Entic Haplorthods |
| Manawa | Fine, mixed, mesic Aquollic Hapludalfs |
| Manistee | Sandy over clayey, mixed, frigid Alfic Haplorthods |
| Markey | Sandy or sandy-skeletal, mixed, euic Terric Borosaprists |
| *Matherton | Fine-loamy over sandy or sandy-skeletal, mixed, mesic Udollic Ochraqualfs |
| Menominee | Sandy over loamy, mixed, frigid Alfic Haplorthods |
| Menominee Variant | Sandy over loamy, mixed, frigid Alfic Haplorthods |
| Mosel | Fine-loamy, mixed, mesic Aquollic Hapludalfs |
| *Mussey | Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls |
| Namur | Loamy, mixed Lithic Haploborolls |
| Nichols | Coarse-silty, mixed, frigid Typic Eutrochrepts |
| Oakville | Mixed, mesic Typic Udipsamments |
| *Omro | Clayey over loamy, mixed, mesic Typic Hapludalfs |
| *Onaway | Fine-loamy, mixed, frigid Alfic Haplorthods |
| *Pella | Fine-silty, mixed, mesic Typic Haplaquolls |
| Poygan | Fine, mixed, mesic Typic Haplaquolls |
| Rodman | Sandy-skeletal, mixed, mesic Typic Hapludolls |
| Roscommon | Mixed, frigid Mollic Psammaquents |
| *Ruse | Loamy, mixed, nonacid, frigid Lithic Haplaquepts |
| Shiocton | Coarse-silty, mixed Aquic Haploborolls |
| Solona | Fine-loamy, mixed Aquic Eutroboralfs |
| Symco | Fine-loamy, mixed, mesic Aquollic Hapludalfs |
| Udifluvents | Loamy, mixed, mesic Udifluvents |
| Udorthents | Loamy, mixed, mesic Udorthents |
| *Wainola | Sandy, mixed, frigid Entic Haplaquods |
| Wauseon | Coarse-loamy over clayey, mixed, mesic Typic Haplaquolls |
| Waymor | Fine-loamy, mixed, mesic Haplic Glossudalfs |
| Zurich | Fine-silty, mixed, mesic Typic Hapludalfs |

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